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[Special Editorial Correspondence.]

THIRTY-FIRST ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

RUSSELL HOUSE, DETROIT, MICH., October 21, 1903.

Dear JOURNAL: The American Gas Light Association entered on its fourth decade of usefulness to-day with every indication that the purposes of its founders were to be fostered in increasing measure. As your readers well know through timely advertisement the meeting place was Detroit, the headquarters were the Russell House and the convention room was in Masonic Hall. Everyone who has visited Detroit knows that it is a handsome city, those familiar with the capabilities of the Russell must concede that no better shelter is known in the Wolverine State—in fact, its covering and service are up to the needs of anyone from any State—and the men who attended the technical sessions will all undoubtedly agree that the assembly room could not be improved upon. Wherefore the Committee of Arrangements must and did receive the laudatory thankfulness of the large delegation of men and women who participated one way or another in the thirty-first convention of the American Gas Light Association. To complete the comfort of the visitors the weather conditions were of the finest "Indian summer time," although no real "Mackinaws" were on the scene to say what the weather was compared with that of the days in Fall when Hiawatha crooned his sad lay. The meeting was called to order at 10 A.M. to-day, by President Alten S. Miller, whose clerical appearance seems none diminished by his stay in Baltimore, since his severance from the gas people who dwell in Irving Place in your city. President Miller introduced Mayor Mayberry, who in the usual manner welcomed the Association to the city, and his welcoming was cleverly responded to by Vice-President Cowdery who, although now a resident of St. Louis, knows quite a bit about the gas history of Detroit, Milwaukee and other places. The preliminaries having been disposed of routine business took up the attention of the Association. The report of the Council was noteworthy in several things, but certainly in none more so than its lines in respect of recommendations for the election of new members. Under the report 71 names were presented for active, 20 for associate and 36 for junior membership admission, and this accession would seem to prove that for "a separate industry" gas is doing at least fairly well. The President having invited those of the newly elected members present to freely avail themselves of the privileges of their affiliation, the balance of the Report of the Council was considered. The reading of Secretary and Treasurer Forstall's concise annual reports was followed by an eloquent speech from Mr. Frederick H. Shelton, President of the Western Gas Association, outlining what the Western Gas Association proposed to do in the way of showing gas at its best at the coming World's Fair to be held in St. Louis next year, the main features of which proposition have been reported in the JOURNAL. Mr. Shelton's eloquent and impassioned appeal found ready response from his auditors, and there can now be no doubt that the "gas show" at St. Louis will be a "go." The comprehensive report submitted by the Trustees of the Gas Educational Fund was next considered, and its paragraphs proved that the educational measures handed out during the first period of the administration of the fund has benefited many. The report disclosed the fact that Mr. Wm. R. Beal, of New York, who, as President of the Association, directed its meeting in New York last fall, had been chosen to succeed the late Mr. Eugene Vanderpool as Treasurer of the educational fund. The Association then elected the following officers to direct its affairs for the next term:

President—Mr. Rollin Norris, Philadelphia, Pa.
First Vice-President—Mr. Edward G. Cowdery, St. Louis, Mo.
Second Vice-President—Mr. Charles F. Prichard, Lynn, Mass.
Third Vice-President—Mr. Charles R. Faben, Toledo, O.
Members of Council—(Terms expire 1905)—Messrs. A. G. Glasgow, Wm. A. Wood, John Williamson and Walton Clark.

Mr. Irvin Butterworth, Chairman of the Committee of Arrangements, whose recent transplanting from Denver, Col., to Detroit, Mich., does not seem to have disturbed his tranquility in the least, then told the Association what the Committee proposed to do in the way of entertaining, and the planning seemed to meet the approval of everyone. President Miller's inaugural address was next in order. Its lines were quite different as to their import from that which one would expect from a man of his training, methods and habits; but as it is often politic to speak differently in public from the speech in which one expresses his views when not on the stage, a fair inference from the message is that President Miller has not lived in New York in vain. The address having been referred to the usual committee, two rattling good reports came to hand, respectively, from the Committees on "Municipal Ownership" and "Research." The hand of Mr. Rollin Norris showed out in each,

LIBRARY OF CONGRESS. OCT 27 1903 SMITHSONIAN DEPOSIT.

and if praise means continuance he should be satisfied, since each committee was ordered to serve another year. The Secretary having read and otherwise disposed of a great batch of letters of regret, good wishes and the like, three queries from the "Question Box" were disposed of, after which, on motion of Mr. Frederick Shelton, a hearty vote of thanks was passed to the great work of the committee "On a Uniform System of Accounts for Gas Companies," the results of whose labors were commented on in the JOURNAL for September 14th, 1903. It may be well imagined that all these things made up a busy morning session, and luncheon hour was greeted with the appetite born of labor. The afternoon session was commenced at 2:30, the first number on the programme being a paper, by Mr. A. C. Humphreys, President of the Stevens Institute of Technology, Hoboken, N. J., whose special plea for "Our Correspondence School" should be well up in the admiration of the son of his father, Mr. Alfred E. Forstall, who has so capably and closely managed the active affairs of the Association's Educational Class. The next paper was that by Mr. Arthur G. Glasgow, of London, England, the title of which was "The Policy of Gas Enrichment: Illustrated by London Practice." Owing to the unfortunate and sudden illness of the author—Mr. Glasgow, on his way to America to assist in the meeting, was stricken with something akin to peritonitis—this paper was read by Mr. A. C. Humphreys. Its lines, which were largely of the controversial order, brought out a discussion that was of sufficient interest to bring the proceedings to the hour of adjournment. The attendance is large, over 200 being present; and in the assemblage one may count veterans like Young and recruits like (?), which mixing, as I said before in effect, goes to prove that the footsteps of the fathers are often not too small for the sight of their sons. To-day the Committee of Arrangements saw to it that the women folk had a good chance to "do" the city by means of special trolley car, and to-night they are to visit the Detroit Opera House to enjoy the art of that first of American actresses, Miss Maude Adams, in her new play.—"S."

DETROIT, MICH., Oct. 22, 1903.

Dear JOURNAL: The entertainment programme was carried out all right last night. The "smoker" was enjoyed by cigar, cigarette and pipe users to the full, all of the named styles of tobacco users having been especially pleased with a vaudeville of the petite order which wound up the pleasures of the night. The technical proceedings of the second day were commenced with Vice-President Norris in the Chair, whose first warning had to do with the report of the Committee on President's Address, which was read by Mr. Walton Clark. The report having been adopted, the Association indorsed the report of the Committee on Next Place of Meeting, who recommended Washington, D. C. The members then listened to a most interesting lecture on "Gas Engines," by Professor Alfred H. White, of the University of Michigan, Ann Arbor, who well deserved the hearty vote of thanks tendered him on the close of his presentation of the subject. The morning's proceedings terminated on the reading of the paper, by Mr. W. C. Morris, of Long Island City, N. Y., entitled "Notes on the Operation of Large Carburetted Water Gas Sets." His paper was a most interesting one, and so it should be; for Mr. Morris has under his charge some huge generating machines, the total output of which each 24 hours cuts no small figure in the daily sendout of the Consolidated Gas Company of your city. The entertainment features for the delectation of the fair sex, as outlined for to-day, comprise a tallyho trip to and around beautiful Belle Isle. In the evening they will attend the banquet, and to morrow they are to share in the boat ride for which the steamer "Promise" has been chartered. About 60 of the fair sex are present, and the reception and entertainment committees are unremitting in most successful attention to the comfort of their guests. The technical sessions of the second day were commenced with the cleaning out and up of the Question Box, after which Mr. Henry L. Doherty, of New York "and elsewhere," read his paper on "Some Features of Municipal Ownership." As is usual with that which he prepares, his theme was treated with vigor and simplicity, and its reading was followed by a good discussion. I forgot to mention that the Report from the Committee on Electrolysis will be much esteemed by those who will have to wait for its consideration until the publication of the proceedings. The Doherty paper virtually concluded the technical sessions, and I am sure the Beal medal will be awarded this year to some one of the paper writers; for the "class" of the communications was certainly up to standard. The votes of thanks to the retiring officers and to the Committee of Arrangements were beyond doubt bestowed for cause, and after their awarding an adjournment as to business affairs was ordered. —"S."

DETROIT, Feb. 23, 1903.

Dear JOURNAL: The banquet last night was a great success. Over 300 shared its pleasures, and the proceedings were directed by Mr. Donald McDonald, whose art as a toastmaster is of the finished type. The weather remains superb, and at the moment (9 A.M.) all is bustle and anticipation respecting the boat ride, with every indication pointing to the fact that a host exceeding 300 will try the steaming and the staying powers of the "Promise." Not a flaw can be made out from any point respecting the 31st session of the American Gas Light Association, and those who assisted therein will for long time pleasantly remember its harmonies.—"S."

[OFFICIAL.]

Card Index of Current Gas Literature.

WESTERN GAS ASSOCIATION, OFFICE OF PRESIDENT,
1004 PENNSYLVANIA BLDG., 15TH AND CHESTNUT STREETS, PHILADELPHIA, PA., October 19, 1903.

The "*Card Index of Current Gas Literature*," authorized by the Western Gas Association, and upon which the principal work was completed last spring, as reported to the Association at the Indianapolis meeting (see AMERICAN GAS LIGHT JOURNAL, June 15th, 1903, page 928, Report of Library Committee, and also, *Progressive Age*, July 1st, 1903, page 318), is now being sorted and boxed by the printer, and will be ready to ship next week.

The Card Index comprises 1,340 reference cards to all books and recent principal articles upon gas subjects. Every paper before the Western, the American, and the New England Associations, from the beginning, is indexed, and every article of importance appearing in the AMERICAN GAS LIGHT JOURNAL for the past 5 years, 1898-1902—which includes papers before the other Associations for such period, as well as reprints of many important foreign papers.

All books and pamphlets (in English—some 200) from the beginning, in 1804 to 1902, are indexed. This Card Index, in brief, is the key to the best and latest information obtainable on almost any gas topic. It is divided into 77 subjects, the variety of which can best be gathered by the sample box lid label herein:

Card Index.—Western Gas Association.

CLASSIFICATION OF SUBJECTS.

Manufacture.

Retort house,
Regenerative benches,
Isolated generators,
Inclines,
Coke ovens,
Enrichers,
Oil,
Coals,
Conveyors,
Gas coke,
Ammonia,
Tar,
Water gas tar,
Tar paving,
Briquettes,
Cyanides,
Lowe water gas,
Pintsch gas (includes oil gas),
Rosin gas,
Natural gas,
Fuel gas,
Nitrogen processes,
Sundry processes,
Exhausters,
Scrubbers,
Condensers,
Purifiers (includes lime, oxygen processes, coal liming),
Oxide,
Holders,
Holder tanks,
Concrete and foundations,
Governors,
Boilers, etc.,
Works sundries,
Naphthaline,
Chemistry,
Photometry,
Calorimetry.

Distribution.

Mains and services,
Submerged mains,
High pressure (pounds),
High pressure (inches),
Leakage,
Electrolysis,
House meters,
Prepayments,
Ranges (and gas for fuel),
Heating,
Water heaters,
Ventilation,
Gas engines,
Street lighting,
Incandescents (includes open flame and all burners),
Intensified lighting,
House piping,
New business (includes advertising, appliance exchanges and demonstrations),
Complaint work,
Office methods,
Tools,
Management.

General.

Management,
Gas rates,
Gas vs. electricity,
Legal,
State and franchises,
Municipal ownership,
Depreciation,
Taxation,
Labor,
Light vs. illumination,
Associations,
Educational,
General books,
Specific plants,
U. S. Government,
Foreign,
Miscellaneous,

All important topics, such as regenerative furnaces, inclines, coke ovens, water gas, naphthaline, oxide and purifying questions, electrolysis, photometry, chemistry, etc., have 20 to 50 references each; minor subjects are well covered. For instance, there are references to 6 articles on "tar pavements;" "boilers" includes 16 references, covering good articles on boiler settings, injectors, burning breeze, experimental work, mechanical draft, steam separators, heating surface, steam pipe covering, explosions, firing by waste bench heat, etc. The Index is handy and practical. The cards are 3 × 5 inches, printed in clear type, packed in a pasteboard box about 4 × 5½ × 18 inches. The Association further expects to index the 1903 references, and add them to the present set of cards at the next meeting. Users, moreover, can add reference cards of their own and further amplify or classify, as desired. Subscribers to the Index are requested to please now advise the undersigned as to name and exact address for shipping, and by which express, if any preference. Those who have not yet remitted, are requested to kindly do so; heavy printing bills have to be paid. Those who have not yet subscribed are again reminded of the Index, and invited to, as its practical usefulness is felt will be great to any one intelligently using it. Fuller information concerning it will be gladly sent to any desiring.

F. H. SHELTON,
Chairman, Library Committee, Western Gas Association.

Our Correspondence School.

[A paper read at the Thirty-first Meeting of the American Gas Light Association (Detroit, Mich., October 21st, 22d, 23d) by ALEX. C. HUMPHREYS, President Stevens Institute Technology, Hoboken, N. J.]

This is a most fitting time to review the work of our Association's Correspondence School, for the period covered by the subscriptions obtained in 1898 has just expired, and those who have been supporting the undertaking should be given every opportunity to learn by the results so far obtained whether they are justified in continuing that support.

It was therefore suggested that I should supplement the official report of the Trustees, prepared for this meeting, by this paper in the hope that these two presentations of the subject, together with the discussion which should thereby be developed, would serve to place the facts in regard to this important undertaking fairly before the old subscribers, the members of the Association and all others interested in the prosperity of the gas industry.

Many old subscriptions have already been renewed, and, in view of the evidence, it is hoped that not only will the remaining old subscriptions be renewed, but that some of them will be increased and that many new subscriptions will be made.

In February, 1899, I presented a paper to the New England Association of Gas Engineers, under the title "Correspondence Schools," in which I presented the facts in regard to this Association's Correspondence School; and I have also from time to time presented papers on educational subjects to this and other gas Associations.

In what I now have to say I shall to a great extent repeat myself. There are two chief reasons why I shall not hesitate to do so:

First, because since writing the paper first referred to the work of our Correspondence School has been on further trial for 4½ years, and thus the opportunity is now afforded to test the correctness of such of my statements as were based upon estimates and opinions; and, second, because my observations in the past were made almost entirely from the view-point of the man outside of the regular institutions of learning, and so most of my impressions had been received from the study of results in our industry achieved by workers who had gained their technical training through various educational processes; whereas now I am able to speak from the additional experience gained as the head of a school of engineering of the first rank. This last experience, while short in time, has been concentrated and instructive.

It is therefore a pertinent inquiry, "Has this later experience brought about any considerable change in my views on this most important subject?"

In my New England Association paper I unreservedly indorsed the work then being done by the Trustees of the Gas Educational Fund. The work done by the Trustees and the additional experience I have since gained in the line of technical education, both justify me in again strongly recommending this scheme as one of efficient philanthropy and as one which, from a selfish standpoint, we can profitably support.

In 1895 this Association authorized a committee to establish in its name a Correspondence School of Gas Engineering.

Although I do not wish to be ungracious, it is pertinent to my present purpose to remind you that a large percentage of our membership then regarded this undertaking as chimerical or worse, and therefore were not willing to support it, but were only willing to withhold their active opposition. By a few the scheme was actively opposed.

The committee, with the full courage of its convictions, organized and carried on the work until 1898 without pecuniary assistance.

The work of instruction was performed by Walton Clark, a notable example of self-denying devotion to a sense of duty, loaded down as he was with the burdens and responsibilities of his official position.

The results so obtained by this committee were, in the opinions of its members, of such a character as fully to warrant the continuing of the work by means of a more complete and permanent organization and under the charge of a salaried executive.

Those chiefly interested in the movement canvassed for subscriptions among those pecuniarily concerned in the gas business, for it was not to be expected that this Association as such could assume a large part of the pecuniary burden. Subscriptions in a sufficient amount to carry on the work for five years were finally obtained, and, with the co-operation of this Association, a permanent and independent Board of Trustees was organized to administer the funds subscribed and to direct the work of instruction.

In canvassing for subscriptions there was met some hearty encouragement, much indifference and considerable opposition. But in spite of lukewarmness and active opposition a sufficient—though barely sufficient—fund was subscribed, and the scheme was insured a pecuniary support for five years.

It should be particularly noted that a considerable portion of this support came from the manufacturers of gas apparatus, appliances and supplies. All honor, therefore, to our associate members!

So our Correspondence School work was more completely and permanently organized.

A. E. Forstall, the Secretary of this Association, was appointed Secretary, Executive Officer and Instructor.

As is generally known, Mr. Forstall is peculiarly well qualified for this work. A graduate of the Engineering Department of the Lehigh University, he has the additional practical experience gained during years spent in the management of gas works under his father, the late Theobald Forstall.

Alfred Forstall's work as the executive head of our Correspondence School has again proved him to be, both in head and in heart, a worthy son of his great and good father.

The conservatism of the business management of the Trustees is shown by the fact that, although there have been repeated demands made upon the Board to increase its expenditures, each year the expenses have been kept below the income applicable to that year, and the surplus so reserved has been carried into a special fund as the nucleus of a permanent endowment. This fund now amounts to more than $3,000. This should encourage more and larger subscriptions, for subscribers can rest assured that in every case surplus income will go to swell this fund and so further insure the permanency of this undertaking.

The report of the Trustees presented at this meeting has given you detailed information as to the number of those under instruction and the like. I shall not burden you with a repetition of these data, but I wish to impress upon you the fact that a considerable number of our students have already been enabled through our instruction to take higher positions in our business, and that a further considerable number are now being helped to a greater efficiency as employees and wage earners.

Let me recommend to you a careful reading of the circular letter and accompanying papers issued to our subscribers under date of May 21st, this year. These papers set forth the value of the work done and furnish to the subscribers sufficient reason for renewing their subscriptions. There is one figure which can be established from that circular to which I wish to direct your attention, namely, the average yearly cost of instruction for each student. The criticism has been made that this cost is so high as to show that the scheme of instruction is inefficient in operation. If we take the total cost per annum as $4,000, and the total average number of students as 100, we have a yearly per capita cost of $40.

At Stevens Institute of Technology the minimum yearly tuition charge is $150 (considerably less than at some other of our engineering schools), and from the endowment there is supplied an additional $100 per annum; that is, the full cost of tuition for each student is about $250 per annum. The additional cost to each student for books and materials is about $50 per annum, making a total of say $300, or 7½ times the total cost per capita in the Association's Correspondence School.

Moreover, the students of our Correspondence School have the additional pecuniary advantage that they can continue and improve as wage earners while pursuing their studies.

I quite appreciate that the two schemes of education so widely differ that a fair comparison cannot be thus made, but as the criticisms I have referred to were made in connection with such a comparison, what I have here shown will at least serve to meet those criticisms.

No doubt the cost per capita in our Correspondence School is much in excess of the cost per capita in the large correspondence schools. In the latter, education is carried on wholesale and the plant and equipment do not have to be increased in proportion to the increase in enrollment of pupils, and so the cost per capita is low by reason of the thousands of students enrolled.

But surely we may believe that in the teaching of *our specialty* we are able to do for our students more than could be done for them by any of those mammoth correspondence schools. The very fact that our number is so limited is all important. Though our instructor does not come in personal contact with the instructed, each case is individually considered and treated, and just as much in the way of personal teaching is accomplished as is possible through correspondence methods. To obtain anything approaching a high degree of efficiency in teaching, there must be individual teaching. I am inclined to think that, if we are to maintain our present efficiency, we have gone almost as far as we

can go with a single instructor. A considerable addition to our classes would require at least one additional instructor, who should be specially qualified, technically and practically. As the salary of our instructor is by far the largest item of cost under our scheme, the minimum cost per unit has been nearly reached.

It cannot be fairly claimed that a technical education as complete as that obtainable in our best technical schools can be obtained through any correspondence school. On the other hand, it is a fact that the students of a correspondence school, as far as they go, have fuller opportunity than do the college students to carry along together the theoretical studies and the practical application of those studies.

The students of our Correspondence School possess this advantage to the fullest possible degree, for they are working in the particular business to proficiency in which their studies are directed.

A most important advantage is possessed by the student who, day by day, is practically impressed with the necessity for the knowledge for which he is striving, and then in daily practice has the opportunity to apply that knowledge.

I am inclined to believe that on the average our schools of technology could do nearly as much with their students in three years as they now do in four years, if every freshman as he entered college could be passed through a process which would instantly create in him a keen appreciation of the value of all the subjects included in the curriculum. Instead of this, it remains for many of them to learn after graduation why certain studies were made a requirement for their graduation. Without such an appreciation at the time of study it is impossible for students to get anything like a full value from their course of study.

Here is to be found the reason why certain students, who go to college late in life, having already acquired certain practical experience, but generally with their ability to readily acquire book knowledge more or less diminished, still succeed in getting more out of their course of instruction than do the youths fresh from the preparatory schools. The older students have learned by experience the value of that which the college offers. They have already experienced the need for this knowledge, and they are, therefore, more ready to appreciate to the full the practical applications of the mathematics, physics and chemistry, not to speak of the non-technical branches, which they are required to study.

This is the advantage possessed to an eminent degree by the students in our Correspondence School, and still further than even the older students in the technical colleges, for our students do not have to depend in this regard upon past experiences only, but their appreciation of the value of their technical studies is continually renewed and developed by their daily work.

From a survey of all the questions placed before the students of our Correspondence School during the whole course, it may be thought that but little ground is covered. But there is more to influence the students than appears on the surface. To completely answer the set questions, the students must do a large amount of preparatory study, and in this work they are encouraged and intelligently directed. In studying to answer the set questions, the students will learn much more by the way, and *they will learn how to study and to think for themselves.*

While, therefore, membership in this school is to a large extent valuable, because it incites the students to and directs them in systematic study, that it has in my opinion also a more definite and specific value can be seen from the fact that I advise college graduates who wish to engage in the gas business to subscribe for the questions and answers and so obtain the more closely specialized training which is necessary in every case in addition to the more general and fundamental technical training supplied by the colleges.

The graduate of a good technical school has a great advantage over the man who has only a practical training, *provided* the technical graduate is willing to acknowledge the value of the other man's practical training, and, acting on that knowledge, to supplement his college training by completely mastering the practical applications of theory, and the technical and commercial requirements of the particular specialty in which he is employed. This he should be able to do the more quickly and completely because of his college training.

But first he must recognize the necessity for and be willing to undertake the drudgery to acquire this knowledge which the colleges fail wholly or in part to supply. Here too many technical graduates fail; and so technical training is discredited in the persons of some of its professed exponents.

The students of our Correspondence School, by reason of the conditions under which they work, are but little exposed to this danger.

There are many questions raised to day as to the ultimate value of much of our professional training, and some of these questions are worthy of thoughtful consideration. I doubt the wisdom of turning out as many lawyers and doctors as we are yearly graduating from our colleges and universities. The supply threatens to exceed the demand, if it has not already done so. Possibly in the not distant future the same question may be raised with regard to the product of schools of engineering; though here it is to be considered that the training given in those schools is applicable not only to one line of work, but is applicable to the whole wide range of industrial effort.

But, whatever questions are raised in this direction, there cannot be any question as to the wisdon *of assisting men who are already engaged in the gas business* to fit themselves to more perfectly perform the work entrusted to them and to take higher positions in that business.

Those of us who are pecuniarily interested in the gas business can well afford to support this Association's Correspondence School, if only from selfish motives. But I do not hesitate before the members of this Association, so many of whom I know so well, to appeal to higher motives.

When the day comes, as it will come to every one of us, to review the years spent here on earth, regret upon regret must be experienced for our failures to accept the opportunities offered to us to help our fellowmen. We shall regret our failures to accept such opportunities even when to have done so would have required of us distinct self-denial. What shall we feel, then, in such cases as the present, where this help can be given at the cost of little or no self-denial?

I hope and believe that the subscriptions now expiring will be more than renewed, and that the Trustees will thus be enabled to carry on and extend their work for another 5 years, and that finally an endowment of $100,000 will be secured, thus insuring the permanency of the undertaking. If such a result should be secured, the American Gas Light Association would occupy a proud position among the world's associations of engineers.

Heating Experiments with Oils and Manufactured Gas.

The *Florists' Exchange*, in a special article contributed to its columns by B. T. Galloway, Chief of the Bureau of Plant Industry, United States Department of Agriculture, contains the following interesting notes respecting experiments with some new devices for heating water for use in radiators, with gas and oil as fuels.

Improvements in methods of heating have long occupied the attention of engineers and others, but despite all that has been accomplished, there is still much to learn in this field. For the past year the writer has been making some experiments in the utilization of oil and manufactured gas for heating purposes, and, while in the main the work has been conducted with a view to house heating, the results are equally applicable to small conservatories where the question of a steady supply of heat is essential and the facilities for more or less constant attention are lacking. It is recognized that the work is far from complete, but it has gone far enough to enable us to offer some suggestions which it is hoped may influence others to continue it.

Oil (and by this material we mean the refined product, kerosene) may be dismissed with a few words, as, after many trials with numerous devices, it is found to be impracticable as a means of heating water or generating steam. In all of our experiments, oil and gas were used to heat water circulating either in pipes or ordinary radiators. Taking an ordinary heating plant, say, with a radiating capacity of 500 to 1,000 square feet, oil, when burned in the boiler with any of the so-called hydrocarbon burners, would be beyond the means of the ordinary house owner. The cost of heating 500 square feet of radiation, using kerosene oil and the best devices we have been able to secure or make, would be about three times as great for oil as compared with anthracite coal, provided coal was selling at $6 per ton delivered in the cellar, and oil at 10 cents per gallon delivered in the same way. Then the labor of handling oil, watching the burners and keeping the apparatus in order is fully as great as that connected with putting in coal and taking out ashes. Furthermore, we have never seen an oil device that could be entirely trusted, as experience with them shows that, when least expecting it, they go wrong, and fire and explosion follow unless great care is observed. The utilization of oil, therefore, as described, is hardly to be recommended.

There is one method of utilizing oil, however, which is worthy of further trial and consideration—viz., that of adopting as a burner the ordinary blue flame oil stove, of which there are several kinds on the market. The burners for these stoves can be bought separately. They have a gravity feed and will run indefinitely with little care and attention. They are as safe as an ordinary stove, provided, of course, they are not

allowed to come into close contact with woodwork, where the flames may be blown about by the wind. The nature of these burners is such, however, that they cannot be utilized in connection with the ordinary cast iron boilers. They could be used by adopting special heating devices, inexpensive in their nature and similar to those which will be more fully considered in connection with heating water by means of gas. The idea in brief is to bring the water to be heated directly in contact with the flame of the burner, and to arrange these individual heaters in a battery of as many as may be desired. Some experiments made in this connection indicate that with properly constructed coils a large percentage of the heat units in the oil can be utilized. Even in this event, the question of obtaining oil, keeping the tanks filled, looking after the asbestos wicks, etc., must receive full consideration. The labor involved in these various operations offsets some of the advantages that the oil has over coal, and even with the best devices coal is considerably cheaper. As already indicated, however, this is in a line of experimentation that is worthy of further development.

It is with ordinary city or illuminating gas that the most encouraging results have been obtained in heating water. Our first experiments were of two kinds: (a) the use of gas in a cast iron boiler forming part of an ordinary heating plant; and (b), the use of gas in specially constructed boilers—*i. e.*, substituting the specially constructed boiler for the ordinary type in use. This was done because it was found that boilers made for coal with their arrangements for cinders, drafts, etc., were poorly adapted for the use of a fuel as costly as gas. Only a small portion of the efficient heat units in the gas could be utilized, the rest going up the chimney or being lost in overcoming the resistance offered by the iron and in other ways. With specially constructed boilers, and by such we mean those where the flame of the burning gas can be brought into direct contact with a large surface of some metal like copper, much more effective results can be obtained than where ordinary boilers made for coal are used. Types of such boilers are to be found in those used for automobiles containing either a large number of small copper tubes or consisting of series upon series of copper coils through which the circulating water passes. Even with such devices, however, it has been found impracticable to sufficiently heat the water from a central plant except at a cost considerably more than that of coal at ordinary prices. In actual practice the cost of the gas would be about double that of coal, the price of the latter being estimated at $6 per ton, and the former at $1 per 1,000 cubic feet, 22-candle power. Of course, in this case there is no coal man to bother with, no ashes to take out and no trouble in regulating the apparatus with the proper devices at hand. Theoretically and practically, too, for that matter, there is no reason why a householder could not light his burner in the autumn and the apparatus would do the rest until it was time to turn the gas off in the spring. By means of properly adjusted regulators, the gas would be fed to the burner in sufficient amounts to maintain a uniform temperature in the rooms above. With gas at present prices this method of heating would be practically prohibitive for many, notwithstanding its advantages.

These and other considerations led us to make experiments which had for their basic idea the bringing of the gas directly to the radiator and utilizing it there. The advantages to be found in this plan were:

1. Ability to control the temperature in each room at will.
2. The securing of a portable hot water heating apparatus which could be moved anywhere at any time where gas connections were available.
3. Absence of all dust and dirt.
4. Independence so far as the coal man is concerned.
5. Cheapness over gas consumed in a central plant.

It is unnecessary to describe the various devices which have been made and tested in this work. The results at first were not very encouraging, but later, with the knowledge gained by experience, better success was secured. The proper burners, the generator or heater itself, the relation of air and gas to be fed to the burner, the reliability of the burner and mixer so far as relates to constant burning, the removal of the products of combustion from the room so as to keep the air pure, were all questions that had to be met and solved. It was found that there was a great difference in the efficiency of different generators. One generator burning 10 feet of gas per hour would in a specified time raise the temperature of the water in a radiator containing 100 square feet to an average of 120°. Another burning the same amount of gas and under the same conditions would raise the temperature of the water to 150° in the same time. The most efficient device is one we have constructed ourselves and which we hope to describe in full later when further improvements have been made, especially in the burner.

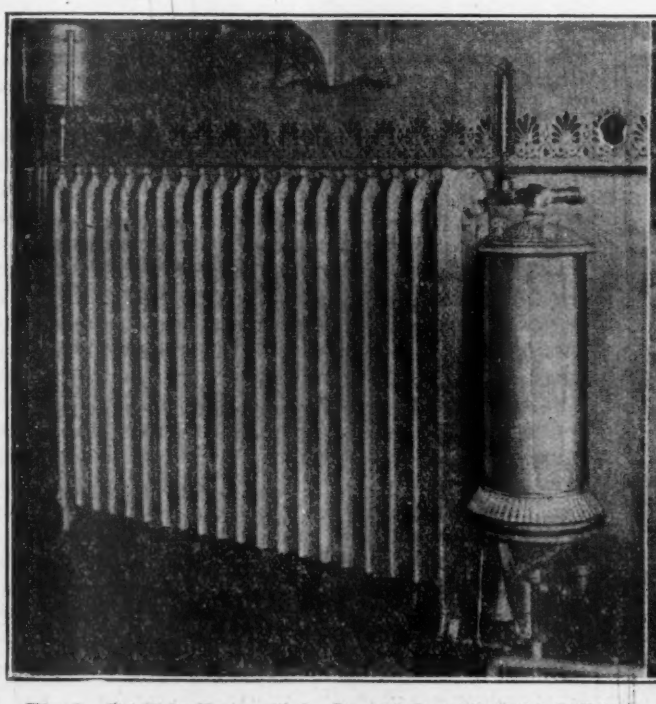

Fig. 1.—Hot Water Heater with Gas Burner in Base Attached to Radiator.

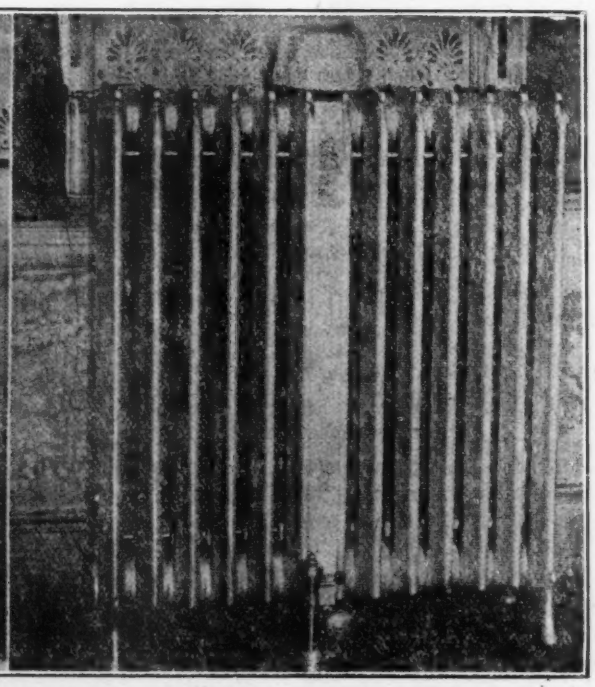

Fig. 2.—Gas Hot Water Heater Forming Part of the Radiator.

Now, as to actual practical results, we will say that during the last winter we proved to our own satisfaction that a room 16 by 18 feet with an 8-foot ceiling could be heated during the coldest weather with a gas consumption of 6½ feet per hour. This room contains 5 large windows and is exposed on 3 sides, so that the test was a severe one. During this test the temperature of the outside air was at times in the neighborhood of zero Fahrenheit. The temperature of the room varied between 66 and 70 the entire time.

During the test, furthermore, the windows were not kept perfectly tight at night. Ventilators were in two of the windows and these were in use during the entire time. We have run the apparatus for weeks at a time, without having to touch it, on 3½ to 4 feet of gas per hour, the weather conditions being such as we ordinarily find in this climate during February and March. This apparatus was attached to a radiator containing 100 square feet of radiating surface with a water capacity of 13 gallons. The apparatus is shown in Fig. 1, with the generator on the right side. In this case the small pipe for carrying off the combustion products is taken off. Our usual practice was to carry the pipe (2-inch galvanized iron painted to conform to the radiator), directly into

the walls of the partition, the house being a frame one. We have also carried the pipe up to the space between the floors and found that it answered the purpose, no fumes nor odors being detected in the room at all. A more compact apparatus and one better suited for all purposes is shown in Fig. 2. Here the heater or generator is made one of the units of the radiator with a small expansion tank in the center. Provision can be made in this case for carrying the products of combustion into the wall directly behind the radiator. This apparatus is complete in itself and can be carried anywhere, provided there are gas attachments. Six and a half feet of gas per hour is very little more than is burned in one of the ordinary gas lights used for illuminating purposes. The consumption of this amount of gas means a cost of practically 15 cents a day (24 hours) for heating a room of the size already given. It must be remembered, however, that the consumption of gas as indicated was only during the severe weather. Comparing the cost of heating a room of this size with gas and coal, we have the following facts:

Assuming that the room is heated by an ordinary cylinder stove, burning anthracite coal, experience has shown that to maintain a proper temperature in such a room would require about three ordinary scuttles full of stove coal per day. This would mean a consumption of 75 pounds of coal in 24 hours. Coal at $7 a ton, which is about the average price in most parts of the East, means 3.1 mills per pound for the coal; 75 pounds, therefore, would cost 23 cents for 24 hours. We have, then, the following:

For heating with gas, burning 6½ feet per hour, 15 cents.

For heating with anthracite coal, 75 pounds, 23 cents.

Difference in favor of gas, 8 cents.

The foregoing figures will not hold good in all cases in actual practice, for, where heating is effected from a central plant, using coal, the cost would be considerably decreased. We believe it is safe to say, however, that rooms may be heated with gas by the system described as cheaply as with coal from a central plant, with the added advantages for gas, of cleanliness, perfect control and freedom from the usual difficulties connected with securing coal.

So far our remarks have applied wholly to the heating of water in ordinary radiators such as are used in dwelling houses. There is no reason why the devices as described could not be attached to pipe systems in small conservatories and be made to serve the same purposes for which they have been found useful in house heating. Here, by proper adjustment of regulators, the supply of gas could be fixed so as to keep a proper temperature at all times.

The Metric System—Objections Answered by French Society of Civil Engineers.

By W. L. C., in *Iron Age*.

The National Bureau of Standards is in receipt of an interesting document emanating from the American Chamber of Commerce of Paris and relating to the metric system of weights and measures. From time to time certain objections to this system, raised in the United States and England, have been brought to the attention of the Chamber of Commerce, and recently the assertion was made that the people of France still employ the old measures, and that the use of the metric system in that country has not militated against the importation of articles manufactured on the basis of the English system, and especially machine tools, locomotives, typewriters, bicycles, etc. With a view to obtaining authoritative opinions on these points, the Chamber of Commerce recently caused these objections to be formulated into a series of interrogatories and referred them to the French Society of Civil Engineers. After careful consideration a committee of the society has prepared answers to all the questions, treating each inquiry as exhaustively as possible.

With regard to the oft repeated criticism that the meter is not exactly the ten-millionth part of a quadrant of a meridian of the earth, the committee state that, while there is a slight variation, it is of no consequence because the origin of the measurement is unimportant as long as it can be reproduced from other data at any time. The meter and the kilogram are represented by the prototype standards deposited at the International Bureau of Weights and Measures at Paris and are the common property of 21 countries which have subscribed to the convention. Numerous copies of them have been made in platinum-iridium alloy, and have been compared with a precision which for the meter is of the order of two-tenths of a micron, and for the kilogram of the order of one-hundredth of a milligram. These copies, distributed in all civilized countries, insure by their number both the uniformity and the permanence of the metric system to the degree of precision thus indicated, since it is not possible that all these copies should be destroyed at once. In addition, the length of the meter has been compared with the length of certain homogeneous light waves with a precision much superior to that of the first determination of the meter in terms of the dimensions of the earth. Every physical laboratory, therefore, can produce a metric standard of any length by basing it on known wave lengths of light.

With regard to the suggestion that old measures are still in use in some parts of France, the committee state that except in a literary sense this is not true. A few very old people employ the old names, but apply them to the new measures, as, for example, the bushel (boisseau), to designate the decaliter, etc. Following are certain of the questions and answers thereto relating more particularly to the application of the metric system to the manufacturing industries:

Question.—The machine tools, locomotives, typewriters, bicycles, etc., produced in the United States are made with the assistance of the British measures. It is fair to say, more particularly with reference to the machine tools, that certain parts, such as the standard screws and the verniers, are constructed on the metric system when these machines are intended for France. Has the fact that, aside from this detail, all these machines are constructed with the assistance of the British measures ever influenced their importation into France, or affected in any manner their efficiency or their productivity in French works? Supposing for the moment that the American machine tools were made entirely on the metric system, would any increase result from that in the number imported into this country? Would France have used more machines than it has used during the last 5 years on account of this fact, or even from the fact that the adoption of the metric system in general by the United States were an accomplished fact?

Answer.—With reference to small machine tools, articles like bicycles, typewriters, etc., which are sold by the piece, the question of the unit of measure has little importance; however, with reference to typewriters, American manufacturers have been obliged to combine the keyboards of these instruments in such a manner as to satisfy the exigencies of the French language. It is the same way in all cases in which the measure is an essential quality of the instrument. Thus several American firms are exporting, not only to France, but to all the European countries, excellent measuring instruments, calipers, comparators, etc., exclusively metric. It is absolutely impossible for them to sell measuring instruments there on any system but the metric. If we consider the machine tools applied to the transformation of raw materials, we may state simply that the importations from the United States, which, in 1900, represented 27 per cent. of the total importation, have fallen to 16 per cent.; while Germany, which has adopted the metric system, has seen its importations pass from 33 per cent. in 1900 to 46 per cent. in 1901.

Question.—Is it not reasonable to admit that the choice of machine tools is determined only by practical consideration of productiveness, efficiency, price, delay in delivery, etc., and independently of the system of weights and measures used in their construction?

Answer.—Although the choice of machines is determined by practical considerations of productiveness, efficiency, etc., and although the United States seems to combine advantageous conditions, we have just established that the countries which use the metric system seem to order by preference from the countries whose system of measures is in harmony with their own. It is not possible to express the value in figures. But the influence is unquestionable. Thus some great company or corporation may be dissuaded from the purchase of foreign machines by reason of the difficulty of procuring later in France parts for the replacement of those of the machine, for example, such as parts with a screw thread of different pitch from those in use in this country.

Question.—Can it be admitted, on the other hand, that the United States would import from France a greater quantity of silk, feathers, leather, machines, musical instruments, optical and measuring instruments of precision, wines, automobiles, etc., if France made use of the British system of weights and measures? Is it not logical to recognize that the amount of products into the United States from France is entirely independent of the system of measures employed in the two countries, and depends solely upon the quality, productivity, adaptability, price and delay in delivery of these products in conformity with the general law of supply and demand?

Answer.—The system of measures used, whatever it may be, is evidently without effect on the products for which these measures do not have their application, such as silk goods, feathers, leather, manufactured goods, etc. Whatever the system used, France cannot pretend to export to the United States any but the products of which the conditions seem favorable to the latter nation; it will submit to the effects of the

law of supply and demand. The effects of this law are greatly influenced and often perverted on the American market by the application of prohibitive tariffs. Although for entry into France the American manufactures (not counting raw materials exempt from all duties) pay on the average 10 per cent. of their real value, French manufactures are subjected to duties determined arbitrarily by the officials of the American custom houses, duties which amount to from 60 to 100 per cent. above the price of purchase in France.

Question.—Suppose a better system of weights and measures than the metric system could be found, one in which the units would be incommensurable with those of the latter, would France voluntarily abandon the system it possesses, and would it legally impose the new system, confirming it in spite of the serious disturbances the change would run the risk of producing, and of the immense loss of capital accumulated in the form of plans, transactions, technical literature, weights, measures, balances, tools, etc., which would result from it?

Answer.—This question is purposeless, and there is no serious basis for answering it at the present time, in the improbable case that that contingency should present itself. It can only be said that, as far as the history of measures permits us to go back into the past, there is no system of measures which has presented the advantages of the metric system and which has been in such widely extended use. In case an improvement should be made upon it, it must not be forgotten that France is not the only country to make use of it, but that all civilized countries possess a title to it, obligatory or optional.

Summing up the discussion, the committee say:

It is incontestable that the adoption of a single system of measures in the whole civilized world would be a great benefit to international relations. It is incontestable, on the other hand, that none of the systems in existence is comparable with the metric system from the point of view of its organization and of its advantages. A great number of countries have given up their old systems in order to take the metric system, but not one of those which have adopted it has abandoned it, excepting temporarily and for political reasons, in the first years following its introduction. No country has adopted the British system, outside of those which depend immediately on the United Kingdom and the United States. This historical argument, as also the comparison of the advantages of the two systems, shows us that the British system has no chance of being adopted by countries which are not actually making use of it. On the other hand, the metric system is in constant progress even in the countries possessing the British system, while the British system is always falling back. The ultimate fate of the two systems is therefore absolutely certain; and the more the definite introductson of the metric system in the United States is delayed the more the difficult period of the coexistence of the two systems will be prolonged. For it is undeniable that already, at the present moment, the two systems are used there together; the British system in domestic commercial transactions, the metric system in all scientific work and in the greater part of foreign commerce.

Coal Trade Activity Continues.

[By Mr. Frederick E. Saward, in *Iron Age.*]

In many directions the activity in the acquisition of coal land continues; we are taking out the coal at the rate of 300,000,000 tons a year, and that means that new territory must be developed all the time. The special feature seems to be the desire on the part of large interests, such as the railroad companies, to secure a supply against any peradventure in the years to come. Thus one hears that the Santa Fè Central Railway has decided to resume work within a month on its branch into the Hagan coal fields, in Colorado. These coal fields lie between Hagan and San Felipe, and are to be worked on an extensive scale, there being 150,000,000 tons of coal in sight. Strikes of good coking coal are also reported 2 miles north of Cerrillos, New Mexico.

Railroads operating in the Indiana coal fields are at present experiencing a serious shortage of cars to move the great volume of business offered for transportation. Large quantities of soft coal have been laid in by domestic consumers, and this has kept traffic heavy for the last six months, but as the industrial consumption represents about nine tenths of Indiana's coal production, and there is comparatively no storage capacity among those interested, railroad men are confident that the shortage of equipment will prevail all winter.

An important transaction in the development of Southwestern Virginia and Eastern Tennessee, particularly of the Virginia coal fields, occurred last week when the Crane's Nest Coal Company was organized with a capital of $3,500,000, for the purpose of taking over coal properties in Wise and adjoining Virginia counties, aggregating considerably over 100,000 acres. George L. Carter, of Bristol, Tenn., is the president of the new corporation.

The Gordon Land Company, of Madisonville, Ky., has sold all its mineral rights, consisting of several thousand acres of fine coal lands in Hopkins county, to the St. Bernard Coal Mining Company of Earlington. This is said to be the largest transfer of mineral rights ever made in that county by one concern at one time. The St. Bernard Coal Mining Company, of which John B. Atkinson is president, now controls over half the mineral rights in Hopkins county.

Southern railroads are straining every point by improving trackage, by additions to rolling stock, and by extensions to new fields to keep pace with the calls upon them. An illustration of these activities is given in the statement from Middlesboro, Ky., describing the plans for the beginning of actual construction work of a railroad to extend from Middlesboro to Harlan County, Ky., which may possibly be extended across the Virginia border. This road, which will be 50 miles long and of a good grade, permitting the passage of a train of 50 cars, will penetrate the rich coal fields along the headwaters of the Kentucky River on the border of the States of Kentucky and West Virginia, and will open up an opulent region, which has remained partially undeveloped for many years, but which contains every grade of coal with the exception of anthracite.

The earnings of the Baltimore & Ohio Railroad Company have been due, in large measure, to the enormous coal traffic, which for several months past has been on an unprecedented scale. In July the shipments of coal and coke over the Company's lines reached a total of 2,033,546 tons. As the soft coal regions which its lines serve are further developed the Baltimore & Ohio is destined to become a more important factor than ever in the bituminous carrying trade. At the present time there is considerable development work in progress in West Virginia, along the line of the Baltimore & Ohio, which, of course, means additional traffic, and the extensive improvements which have been and are being made on the route between the West Virginia fields and tidewater will facilitate the handling of this increased tonnage. The Company has laid a great deal of new track on that part of the road, and work is being pushed on the cut-off near Cumberland, Md., which will make the line several miles shorter than it is at present.

Col. C. H. Head, of the Cincinnati Southern, states that within a few weeks 15 miles of track are to be constructed from a point on the Emory river near Harriman, Tenn., to the main line of the Cincinnati Southern Railroad, to be built for the purpose of reaching a large number of coal and iron ore mines which are to be opened in that vicinity. A number of local parties have owned valuable coal lands in that section of the State for several years, but have made no attempt to operate mines on account of the lack of railroad facilities.

An ambition that Sir Thomas Shaughnessy, President of the Canadian Pacific Railway, has cherished for some time, has been realized, and as a result he will announce to the shareholders at the annual meeting next week that the Company will be able to secure all the coal needed for the mountain districts from mines on their own property. For some time the Company has had prospectors at work under the direction of W. H. Aldridge, the General Manager of the Company's smelting works at Trail, B. C., and according to the report he has forwarded the coal found near Banff is of a good grade of bituminous.

If the present plans are carried out, some of the most extensive coal mines in Iowa will be opened in Lucas and Marion counties within the next year. The Whitebreast Fuel Company of Illinois has just secured options on a tract of over 14,000 acres of land lying in Dallas township, Marion county, and in the northern part of Lucas county. Seven thousand acres of land lie in Marion county. The option will expire March 1, 1904. The land has been examined and is said to be underlaid with thick seams of fine coal. The Company holding the option is one of the largest concerns of its kind in the Middle West.

The 1st of October, which was looked forward to as a time for revival in the coal trade, did not disappoint those who thought matters would change at that time, and it looks as though the trade had "turned the corner" and would continue to improve from now on. In both anthracite and bituminous coal there has been a distinctly better feeling. The situation is not as acute as it was a year ago; that could not be expected, as the peculiar conditions of 1902 were the event of a lifetime. This is a more normal year, and if the fall activity is not so pronounced as in other years, it must be remembered that neither was the summer dullness anything like what has been the case in the past. A steady, regular movement of coal is to be preferred to spasmodic activity, and operating interests should make it to the advantage of the consumer to assist in this course. Domestic anthracite is already on the basis of advantage in early buying, and it will be the part of wisdom to arrange some similar policy in regard to the steam sizes of hard coal, and on soft coal.

Flexible Tubing.

The *Gas World* reports that the Pforzheim Metallic Tubing Company (Metallschlauchfabrik Pforzheim) make flexible tubing, the nature of which is shown by the figures Fig. 2 is a simple tube consisting of rings screwed into others of the same size, with the aid of a luting thread of rubber or asbestos to promote gas tightness. With a rubber thread the tubing is very flexible and elastic, and the tubing is good for cold liquids and for gases; with asbestos it is not elastic though it is very movable. It stands heat, steam and oil, and is very durable. Fig. 2 is best for cases in which the piping has not to be much disturbed. Fig. 4 shows how the arrangement is protected against any unlocking when the tubing has to be much disturbed, the two tubings being wound in opposite directions. This arrangement can stand very high pressures, up to 200 atmospheres, and it is now made up to 20 inches diameter, so that it is well suited to cases in which gas mains have to dip under an obstacle.

As there is always a slight smell of gas (less, however, than with rubber tubing), another arrangement has been introduced in which the whole is of metal, rendered gastight by seamless metal tubing (Fig. 3), which is itself flexible, but too thin and light to be used alone. Together, the arrangement readily takes any curve, as is shown by Fig. 1, in which, however, the outer covering is of wire.

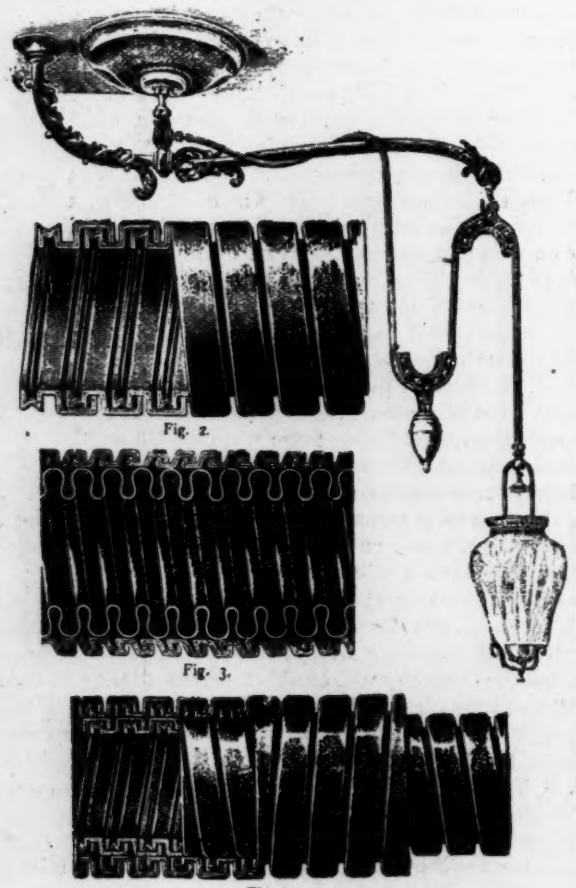

Fig. 2.

Fig. 3.

Fig. 4.

A pattern has also been introduced which, while flexible, is strong enough to carry the heaviest street lamp, and thus the lantern can be raised or lowered by winding the flexible gas pipe itself over pulleys and a drum.

Machinery Defects and Their Causes.[1]

Once again Mr. Michael Longridge, the chief engineer of the Engine and Boiler Insurance Company, places engineers in his debt by the publication of his annual report on engine, boiler and motor breakdowns which have occurred during the previous 12 months. The way of the reformer is proverbially hard, but still progress is evident, and as year follows year owners and users gain more and more experience, and makers also learn to avoid details which experience has shown to involve elements of danger. It is of some interest to compare the origin of the accidents to steam and to explosion engines, and the following figures are given by Mr. Longridge:

1. *Engineering.*

	Steam Engines. Per Cent.	Gas and Oil Engines. Per Cent.
Due to accidents or causes unascertained	30	34
Due to negligence of owners or attendant	23	35
Due to old defects or wear and tear	24	19
Due to weakness—faulty design or bad workmanship.	23	12

It will be seen that with gas and oil engines a very large proportion of the failures arise from the negligence of the owners or attendants, a negligence which probably arises in the main from ignorance, and will be less in evidence as more experience is gained with this class of motor. On the other hand, the fact that only 12 per cent. of the accidents arose from bad design or workmanship is a feather in the cap of the makers of gas engines, since it will be seen that in the case of steam engines the proportion thus originating was nearly double this figure. In accordance with our usual practice, we reproduce here Mr. Longridge's table classifying the nature of the steam engine accidents reported on.

Steam Engines.

	Numbers During 1902	Numbers During Previous 20 Years.	Total.
Valves and valve gear	51	624	675
Spur gearing	16	486	502
Air pump motions	25	309	334
Air pump buckets and valves	10	248	258
Columns, entablatures, and bed plates	10	229	229
Bolts*	5	160	165
Parallel motions, links and guides	6	148	154
Main shafts	2	146	148
Cylinder valve chests and covers	20	144	164
Pistons	7	96	103
Governors and governor gear	4	92	96
Piston rod crossheads	3	71	74
Connecting rods	8	70	78
Flywheels	4	66	70
Air pumps and condensers	5	57	62
Piston rods	5	56	61
Crank pins	2	39	41
Cranks	1	35	36
Gudgeons in beams	1	27	28
Beam and side levers	6	24	30
Total wrecks, cause not ascertained	0	6	6
Main driving ropes	0	5	5
Second motion shafts	0	3	3
	191	3,141	3,332

*These do not include bolts in pistons, air pump buckets, connecting rods in the moving parts of valve gear, bolts in these parts being included with the parts themselves.

It will be noted that valves and valve gearing still retain their preeminence in the matter of causing trouble; and next to them come air pump buckets and valves. Spur wheels, which at one time were a frequent source of dangerous accidents, are now much less in evidence, partly, no doubt, because very large spur wheels are now less used for driving mill shafting than was the case up till recently. On the other hand, failures of steam chests and cylinder covers are becoming more and more common, and are, to a very large degree, attributable to the rise in steam pressures.

Perhaps the most remarkable accident noted in Mr. Longridge's report is the breakage of a crank pin of a horizontal Corliss engine. This pin was 6 inches in diameter at the journal, and was tapered into the crank cheek, its diameter at the large end of the taper being 7¼ inches, and 7 inches at the other end, where it joined on to the journal with a well rounded fillet. It was thus, in accordance with good practice, much larger inside the crank web than at the journal. Neverthless, it broke in two just inside the eye of the crank, the fracture commencing in the fillet. The calculated stress on the metal was only 6,000 pounds per square inch, and the crank had made some 270 million revolutions. Mr. Longbridge refers to the failure as a mystery, and has never met with a similar case. We can only suggest that the metal may have been of inferior quality for its particular purpose. Not so many years ago much alarm was felt at the spontaneous fracture of certain mild steel boiler plates which had satisfactorily passed the inspection tests. It would seem quite possible that material of similar character had been used in this case. Perhaps a micrographic examination of the pin would have afforded interesting information. Such an examination, however, is not well suited for workshop or acceptance tests, as it takes too long to make; but there is good reason for believing that the notched bar impact tests, recently introduced, may meet the want. They cer-

tainly show up the "fragility" of bad metal in a most emphatic manner. In two steels of very similar characteristics, as indicated by ordinary bending, tensile, and impact tests, very marked differences may appear if the bars are notched before making the impact tests on them. Another very curious accident discussed is one in which a bolt belonging to the big end of a connecting rod broke in service, not, however, through the threads, as might, perhaps, be expected, but in the body. The fellow bolt, which by this breakage had the whole of the load thrown on it, and at a considerable leverage, merely bent, without giving way. The calculated stress on the broken bolt was only 3,400 pounds per square inch.

Referring to an air pump breakage in which the plunger was of the trunk type, Mr. Longridge remarks that nearly all trunk motions insured by his company have broken down at one time or another. The pin is generally inaccessible, dirt and grit accumulate at the bottom of the trunk, and wear takes place, which is followed by "knocking," and results ultimately in a complete breakdown.

A good many accidents have arisen from water getting into the cylinders of engines. Where much water enters, relief valves are useless, since they cannot be made large enough. Two cases of breakages thus occasioned are discussed in detail in the report. An interesting case in which a safety gear failed to act is described as occurring with a McNaughted beam engine. This, in addition to the ordinary governor, was provided with a "knock-off" emergency gear intended to shut off steam completely in case of the engine running away. In the absence of the engineman, the engine began to race, and the operatives, not unnaturally, immediately threw off their engines, thus further reducing the load on the engine. The safety gear failed to act, and finally the flywheel burst, causing a total wreck. The position of the knock-off gear had previously been objected to by the insurers, but the owners of the engines had neglected the warning.

Some very remarkable instances of steel shafts being badly worn by their journals are recorded in the report. In one case the engine in which this occurred was provided with forced lubrication, the journals running on white metal. In 15 months the wear of the journals amounted to from $\frac{1}{32}$ inch to $\frac{1}{16}$ inch. The white metal linings were hardly worn at all. No reason for the rapid wear was discovered. An analysis of the bearing metal showed it to consist of 75.77 per cent. tin, 12.90 per cent. antimony, 6.72 per cent. lead, and 4.61 per cent. copper.

A microscopic examination similarly failed to detect signs of grit. In another case a heavy shaft, after running satisfactorily for 17 years, had the white metal in one of the brasses renewed, and 10 months later the shaft had worn in the journal to a depth of over $\frac{1}{8}$ inch. Another curious case of wear is described in the section dealing with electromotors. Here the armature shaft had ring lubricators. These rings were of brass, and in the course of $3\frac{1}{2}$ years one of these rings had so worn away the shaft below it that fracture took place; the ring itself was hardly worn at all. Of course, these cases would be intelligible if particles of emery had embedded themselves in the soft metals, which would then act as laps, but no traces of any such abrasive were discovered.

Valves and valve gears have also been responsible for the highest proportion of failures in gas engines, but trouble has also arisen from jackets being burst through frost, and in other cases quoted the cylinder was cracked by overheating, due to the furring up of the water jacket, for the cleaning of which no provision had been made. A failure which should receive the attention of designers is that of a gas engine shaft supported on three pedestals. When the engine is of the horizontal type, it is impossible with the class of the labor usually available to keep the three journals truly in line, since the brasses wear in two directions. Undue strain is thus put on the shaft, and in the case reported on led finally to the wrecking of the engine. With vertical engines there is less difficulty with a 3-bearing support for the shaft, since the wear is all in a vertical direction, so that changes of level alone have to be considered.

The insurance of electric motors must apparently be a highly speculative business. Taking a general average, 1 dynamo in 12 has an accident during the year, whilst 1 motor in 8 may be expected to break down. These are average figures, but in certain industries the "mortality," if one may use the term, is much higher, since, on the average of motors employed in collieries, 1 in 3 breaks down annually; whilst of those used in actual coal cutting, the casualty rate is as high as 50 per cent. Further, this class of machine suffers from general deterioration to a marked degree. In the case of motors, fully one-fourth the failures arise from old age. The insulation has perished to such an extent that, if disturbed, it falls to pieces, and damage to a single conductor, therefore, involves the complete rewinding of the armature. Overloading, as a cause of failure, is apparently less common, but is still responsible for one-seventh of the total motor breakdowns. In one case a 2-horse power motor, designed for a current of 17 amperes, was fitted with a "fuse" consisting of a length of No. 18 B. W. G. copper wire calculated to melt at 108 amperes. On test it was found that the working current varied between 23 and 27 amperes, rising to 30 at starting. In a sister motor of the same size, the current at starting rose to 105 amperes. A curious accident noted is the fracture of the armature shaft of a small motor. The break started in a V-groove less than $\frac{1}{16}$ inch deep, turned in the shaft to prevent the creeping of oil. The localization of strain thus occasioned is an obvious source of weakness.

The reports on boiler failures contain less that is novel. Perhaps the most interesting point is the fact that whilst a steel boiler using a particular water required new plates at the end of three years, an iron boiler working under similar conditions did not require new flues for seven years after starting. Some interesting cases of steam pipe failures are commented on. In some instances these arose from defective brazing, but in others water hammer was responsible. It is most important in designing steam piping that there shall be no long horizontal length in which water can collect. The provision of drains has proved entirely inadequate to protect such lengths of piping. Where horizontal pipes have to be used, they should couple up to a vertical pipe extending down below the horizontal length, and the lower portion of this vertical pipe should connect to a steam trap. In many cases of damage from water hammer, a horizontal pipe not thus protected fills partially with water, with steam above the upper surface. The water being undisturbed, the lower portions of it are much cooler than the steam. If, now, a drain or valve is opened, the water is agitated, and the cooler water rising to the surface, a sudden condensation of the steam above it takes place, and fresh steam rushes in from the boiler at a tremendous velocity to make good the vacuum. This rush of steam carries with it the water, which is flung at a high speed against some bend in the pipe or valve box, which is often unable to stand the shock.

The Nernst Lamp.

The catalogue of the Nernst Lamp Company, Pittsburg, Pa., has this to say respecting the Nernst lamp system: Artificial illumination is one of the necessary luxuries of life, and methods of producing it are older than history, but it is only the past few decades that have witnessed extraordinary activity in improved sources of supply. It is also interesting to note that of all the illuminants which have ever been used none has been discarded.

Through the agency of arc and incandescent lamps, electricity plays an important part in our manner of living, and electric lighting is recognized as being far superior to any other in point of health and convenience. Nevertheless, it is a well recognized fact that our present methods of illumination are still very inadequate, particularly in point of efficiency, and scientists and engineers are continually striving for improvements in various directions.

The nucleus, or light emitting element of the Nernst lamp, is termed a "glower." It is made by passing through a die a dough composed of the oxides of the rare earths mixed with a suitable binding material. The porcelain-like string thus formed is cut, after drying, into convenient lengths. It is then baked, and terminals are attached, by means of which a current of electricity may be passed through the glower.

The terminal connection between the glower and lead wire, as Dr. Nernst usually made it, consists of a few turns of platinum wire wound around each end of the glower, the convolutions being finally pasted with cement. Another successful terminal is one in which beads of platinum are embedded in the glower ends and to which lead wires are subsequently attached; with this, any shrinkage of the glower material results in a firmer contact with the platinum.

The glower of a standard 220-volt Nernst lamp is about 1 inch long by $\frac{1}{32}$ inch in diameter. This glower possesses many interesting features and advantages. It is an oxide incapable of further oxidation, therefore operative in the open air, and being capable of constantly withstanding a much higher temperature than is the filament of the ordinary incandescent lamp, it admits of great economy of operation and provides a superior color and quality of light. Glowers are insulators when cold, but become conductors when hot, hence they must be heated before they will conduct electricity sufficiently well to maintain themselves at a light emitting temperature.

From the many phenomena observed in studying the operation of

glowers under various conditions, it seems altogether probable that the glower is a solid electrolyte, and furthermore, oxygen apparently is useful in its operation. The electrolytic phenomena appear to be more marked with direct than with alternating current, and it is thus found desirable in practice to provide a different form of glower for each system.

The characteristic of the glower with reference to voltage and current is remarkable, and has given rise to a steady resistance called the "ballast." As the current traversing the glower is increased, the voltage across its terminals rises, at first rapidly, and then more and more slowly to a maximum; it then drops off with increasing rapidity as the current through the glower and the resulting temperature continue to increase. Beyond the point of maximum voltage, the rapid decrease in the resistance of the glower makes the current difficult to control. Without a steadying resistance such a conductor would rapidly develop a short circuit and "flash out." In the Nernst lamp this steadying or ballasting is accomplished by means of a fine iron wire mounted in a small glass tube, somewhat resembling a miniature incandescent lamp. The diameter of this wire in a .4 ampere ballast is about .045 mm., or less than .002 inch—smaller than a hair.

Iron wire possesses the property of increasing its resistance with great rapidity on reaching its so-called critical temperature. This increase of resistance with temperature is true to a certain extent of all metals, but iron possesses it to a remarkable degree when at a dull red heat.

This change of electrical resistance at the critical temperature is only one of several noteworthy features. Other characteristics are loss of magnetic properties and change in coefficient of expansion, as well as marked thermal peculiarities known as "recalescence."

To prevent the rusting or oxidation of this fine iron wire, which at the operating temperature would occur immediately in the open air, the inclosing bulb is first exhausted of air and then provided with an inert atmosphere. This gas has no injurious action upon the iron, while its great heat conducting capacity permits of the use of a smaller wire, and, therefore, of a much smaller ballast, than would be possible with other gases.

The decided negative resistance temperature coefficient of a glower may thus be more than counterbalanced by the more pronounced temperature coefficient of the iron wire ballast placed in series with it.

A glower could be controlled by a sufficiently large steadying resistance possessing no especial temperature correction, but such a resistance would reduce very materially the net efficiency of the lamp; the resistance required under high voltages would be ever present under the normal conditions, in distinction from the ballast which has a comparatively low resistance in similar cases, but automatically increases its resistance for abnormal rises in voltage. It is also important to have the corrective property of the ballast immediately available to check even a momentary rush of current through the glower at starting, or, in fact, at any time. This requires that the ballast shall possess small heat capacity. To attain this important feature the iron wire is mounted freely in the gas contained in the glass envelope and is thereby capable of instantly assuming the new temperature imposed on it by a change in line voltage.

The construction of a commercial and entirely automatic lamp requires, in addition to the glower and ballast, a device to provide for the initial heating of the glower. Though numerous methods for effecting this heating have been suggested and tried, it is natural that electrical means should prove to be the more practical.

The glower becomes a good conductor at about 600° or 700° C. To acquire such a temperature quickly and without rapid destruction of the heater and adjacent parts, renders the selection of the materials for the purpose a serious problem. Platinum for the heater may seem costly for the commercial lamp, but, although many attempts have been made to devise a cheap mineral heater, platinum still holds its own as the least expensive, the most durable, and altogether the most desirable for the purpose. The actual expense is not at all serious, because a large per cent. of the platinum thus used may be recovered.

The heaters consist of thin porcelain supports overwound with fine platinum wire which in turn is held in place and protected from the intense heat of the glowers by a refractory paste.

The automatic lamp is constructed with a cut-out to disconnect the heater from the circuit as soon as the glowers light. The cut-out comprises a coil, an armature and a contact. The coil is heat-proof, being imbedded in cement. The contact is non-oxidizable, being of silver.

Briefly, the action of a Nernst lamp when the switch is turned on is as follows:

(1) The current passes through the heater bringing it to a white heat; (2) the proximity of the glower to the heater results in the glower becoming a conductor, through which the current then passes; when the current through the glower has reached a predetermined amount; (3) the cut-out coil becomes energized by virtue of the glower current passing through it; (4) the armature of the cut-out which had heretofore closed the heater circuit is attracted; and (5) this opens the heater circuit, leaving only the glowers in operation until the next time the lamp is turned on. Ordinarily about 30 seconds is the time required for starting. Opening the switch which controls the lamp circuit allows the cut-out armature to fall into place again, thus connecting the heaters ready for starting.

Although the Nernst lamp may be made to operate in any position, the present line of manufacture is directed more particularly toward lamps to be hung in a vertical position to gain the advantages possessed by a downward distribution of light.

The main features are alike in all the lamps. Various sizes are made by assembling one or more standard glowers with their requisite holders, ballasts and cutout.

The replacement of perishable parts has been made ideal in its simplicity by the use of aluminum plug contacts for glowers, heaters and ballasts, instead of the corroding contacts and troublesome screws so often used in electrical devices. Prompt renewals in Nernst lamps are still further facilitated by mounting the perishable parts on a removable piece called the "holder," which may be pushed into place like an incandescent lamp into its socket. In fact, the housing of the lamp which contains the ballast and cutout may be considered as a special Nernst lamp socket. With a few spare holders on hand, the inspector or user has only to pass from lamp to lamp, changing the holders when necessary and then reloading the old holders at some convenient time and place.

The 6-glower lamp is typical of all the others. This lamp is hung from a suspension eye which, being removed, allows of immediate access to the inner parts. On removing the housing, we find the ballasts arranged in a semi-circle around the cutout and easy of access.

All parts are mounted on porcelain; there being no combustible material in the lamp.

The 6-glower holder is provided with 9 contact prongs, which, when the holder is placed in the lamp, automatically make the desired connections between individual glowers and their corresponding ballasts.

The holder of the Nernst lamp is replaced in a manner similar to the removal of an incandescent lamp.

The horizontal glower Nernst lamp has been designed to throw the largest amount of light in the direction of greatest use. A totally different distribution of light from any other electric lamp heretofore made is thus obtained.

A most effective illumination may be obtained by placing the units of light well above the line of vision, preferably in the ceiling, so that the light is thrown downward. In this manner a uniform and highly satisfactory illumination is obtained.

It would seem that this superior distribution of light should result in the removal of all lights from the line of vision to the great relief of the eyes, and the placing of lamps in the ceiling or as ceiling clusters.

Electric Power for New England Mills.

Dr. F. A. C. Perrine, at the last meeting of the New England Cotton Manufacturers' Association, took up the economics of water power development and suggested a change from the present practice of each mill generating its own power to a system whereby power for all the mills in a given district would be generated and distributed from a central station plant.

New England mills are equipped with both steam and water power, and there is probably no body of men in the country more familiar with variable water power than their superintendents. Water powers not continuous require an equivalent steam power equipment of engines, boilers and men, with interest charges, and in consequence such powers only effect a saving equivalent to the fuel consumption of the steam engine. This, with continuous power and coal at the average New England price, amounts to approximately $36 per horse power year, and in consequence it is not reasonable to contemplate the development of excess power beyond the continuous flow of the stream where the generation of the excess power involves capital and operation charges exceeding $36 per year. Furthermore, it is safe to estimate that this means that one should not expend as much as $600 per horse power for the development of excess power, since a cotton mill organization which can only net 6 per cent. on the investment which it has made for machinery and equipment had better use its money in a

banking business and go out of manufacturing. In fact, it is unwise to develop the variable power of a river where the expenditure for this portion of the developing exceeds on the basis of 12 months' supply of power, $200 per horse power, or, in other words, $100 per horse power for 6 months' power, or about $150 per horse power for 9 months' power. But it is economical to develop the variable power where the continuous power does not exceed in cost $300 per horse power, and the variable power does not exceed $200 per horse power, based upon a continuous rate.

It has been stated that the development for continuous power at a cost not exceeding $300 per horse power produces energy at a rate with which steam plants cannot compete successfully, no matter what the cost of fuel. Dr. Perrine said he is further of the opinion that where the excess power for a development does not cost more than $200 per horse power it more than pays for the saving in fuel alone, and that this condition warrants the development of this excess power and the installation of a steam plant to be operated only during the time of the deficiency of water. As these opinions may not be easily justified in the installation of the plants having less than 1,000-horse power minimum capacity, and as the majority of mills and water powers to which the argument might apply are of less capacity than this, it may at first sight seem that the arguments which have been presented have no particular or general interest; but before hastily arriving at this conclusion, attention should be given to the fact that the development, generation and distribution of power are no more the business of a cotton mill than making investments of a banking character would be.

Cotton mills have been built up along the water powers of New England, and as a consequence we find everywhere wasteful and expensive development of power, a lack of proper railroad facilities and a general disregard for manufacturing convenience in consequence of a choice of site rendered necessary by the domination of the needs of past methods of water power development. Dr. Perrine advocated a centralized plant, developing power for the use of many cotton mills. In many cases this means the purchase of power from a concern altogether independent of the mill itself, though in the future central power plants may be owned by the cotton mills, precisely as they own their insurance companies to-day, with a separate and efficient management and with a common interest and aim. The development of the water powers in large units and not in small units, with auxiliary central steam plants, will permit at all times the distribution of constant power to the mills and the consequent location of the mill with reference to their product and operatives and not with reference to the power. In order to do this it is necessary to abandon the developments of small individual falls and to substitute therefore the unification of many falls into one high head power wherever this can be accomplished by the means of flumes or dams. Whether this shall be done by the individual mills or a separate water power company owned by the mills is a question for each individual case. Generally, in sections thickly covered by mills and intersected by power streams there is no doubt that the central plant can easily utilize and concentrate all powers within a radius of 35 miles, tying the auxiliary steam plants and water power plants together by transmission lines so that the mills will be free, not only from the variation in the water supply but also from interruption of service due to breakdowns of machinery.

It may be objected that the opportunities for accomplishing this have most of them altogether disappeared. This, indeed, is regretfully true, but it is not altogether true, and there are to-day many streams throughout New England undeveloped on account of their fancied inaccessibility, which can readily become available if the question of the possibility of the site of the mill near the water power be considered as unimportant, and if transmission distances of from 25 to 35 miles be contemplated.

The development of water powers at high heads has not only advantages on account of the fact that the inefficiency of many small wheels is eliminated, but also from the standpoint of the storage reservoir, since with the high heads that are sometimes reasonably available the quantity of water necessary to develop a large power is so much reduced that reservoirs become important, which under low heads are of inconsiderable capacity. Along the Boston & Albany Railroad, between Becket and Chester, is to be seen an opportunity of carrying out such a plan as is here in mind. Whether the water in the Westfield river is sufficient for any development may be a question, but it is assumed that the water is in reasonable quantity, as it is used to operate several mills a little below. It will be observed as in traveling along the railroad that a canal of about five miles in length along the hillside would give at its lower end a head of approximately 400 feet, and although there are no mill sites in the immediate neighborhood of such a possible power plant, there are good mill locations within 10 miles down the valley.

In the vicinity of the mills at Dalton is one of the best reservoir sites in the New England States, probably rendered forever unavailable by reason of the presence of Crane's Pioneer and Berkshire mills at the bottom of what might have been a reservoir backing up the water beyond Weston's mill and turning this little branch of the Housatonic from a power stream of comparative insignificance into a stream giving a large, continuous water power.

Down the Housatonic river at Glendale are two powers which have practically been abandoned—that at Glendale and the one at Challenders. The configuration of the ground is such that not only these two powers might be united, but if it were not for the present development of the river, many feet additional head could be obtained in consolidating the heads by fluming the river for a distance of 10 or 15 miles.

The disadvantage of the location of mills along the rivers is most beautifully shown in the neighboring cities of North Adams and Adams, where there are mill after mill with foundations sunk in the river beds at a very considerable expense, and where once every 5 or 10 years great repair bills on account of floods are encountered, though the configuration of the ground is such as would have permitted the consolidation of the water powers into one large efficient central station plant.

The most notable example of the wastefulness of low head development is to be found at Holyoke, where the canals consume space which should be available for good factory sites, and where they are losing from 20 per cent. to 25 per cent. of the entire power developed by reason of the inefficiency of many low head wheels in series. It would not be correct to object that in such a case as that of Holyoke the inefficiency of electrical machinery and transmission would more than counterbalance the increased efficiency of the waterwheels, since we all know that the introduction of the electrical drive will of itself overcome the loss from belting amounting to more than the loss incident to the electrical machinery, and whatever increased efficiency there could be gained by the high head would be clear gain and increased power.

The present day marks an era of consolidation and specialization, and all that has been said is in direct line with this tendency, and is hardly more than calling attention to the fact of the improvements in hydraulics and hydraulic machinery, electrical generation, transmission and application, and the great change now made possible in the methods of power application over anything that has been seen heretofore in New England.

The advantage of these principles has been widely appreciated in the regions of the Rocky Mountains and beyond, and by their application the manufacturers of these regions have succeeded in overcoming their very great disadvantage of inaccessibility and expensive fuel, even where they have had to run flumes and ditches from 5 to 50 miles in length, and have had to transmit power to such great distances that the limit set of 35 miles seems to the Western engineers so short that they do not hesitate at rendering available powers that are at least 100 miles from a possible market.

The reception of the ideas outlined will eliminate many of the present difficulties met in New England from the gradual increase in price of coal, and will tend to solve also some of the questions that are so serious which present themselves with reference to the labor problem, and will aid New England in retaining its cotton manufacturing business, which during the past generation has been so important in its development and prosperity.

Pipe Line Construction.

According to the *Engineering and Mining Journal* there are said to be approximately 25,000 miles of pipe line laid for the conveyance of natural gas in the United States. These are of various sizes, ranging from 2 inches in diameter up to 36 inches. For the transportation of large quantities of gas, or even comparatively small quantities when the line is a long one and pumping is not resorted to, the pipes have to be of considerable diameter. Thus the transportation of 4,000,000 cubic feet of gas per 24 hours (166,667 feet per hour) a distance of 20 miles, with intake pressure of 200 pounds and discharge of 20 pounds, requires a 6-inch pipe. Reckoning 25,000 cubic feet of gas as equivalent to 2,000 pounds of coal, 4,000,000 cubic feet of gas per 24 hours corresponds to only 160 tons of coal. The construction of a 6-inch line will probably cost about $4,750 per mile, or $95,000 for 20 miles. Allowing only 10 per cent. for interest and depreciation, the daily charge is $9,500 ÷ 365 = $26, which would be equivalent to paying for the carriage of coal at 0.8 cent per ton mile. When the intake pressure—*i. e.*, the pressure at the gas wells—falls below 200 pounds, either a pumping plant must be

put in or a larger line must be put down. Remoteness from sources of the gas, therefore, increases the cost of the latter very rapidly. The construction of a pipe line of large diameter is an expensive undertaking, the larger sizes exceeding in cost that of a first-class railway line. Pipe lines for the transportation of natural gas are commonly constructed of wrought iron pipe, technically known as "line pipe," which is tested up to 1,500 pounds. Line pipe is made with longer couplings than ordinary pipe. The standard sizes range from 2 inches to 12 inches in diameter. The smaller pipe lines, say 10 inches in diameter or less, are usually laid with the standard, screw joint line pipe, but lately plain end pipe with couplings and rubber packing has become very popular, and is to a large extent taking the place of screw joint pipe, it being equally cheap in first cost and more readily laid. The pipe line should be buried under ground, so that the distance from the surface of the ground to the top of the pipe will be 18 to 20 inches. This puts the line out of the way and makes it comparatively free from the expansive and contractive force to which it would be subject if it were exposed on the surface of the ground to the direct heat of the sun.

The ditching is not very expensive; in ordinary soil it ought not to cost much more than 6 cents per lineal foot. The pipe should be well protected with coal tar on the outside before laying. Expansion joints should be put in from time to time, say at one-half mile intervals, and also a certain number of gate valves and tees to permit connections to be made at points where they may be required. A well laid pipe line suffers comparatively little depreciation in value, and the pipe, after having been in the ground for 4 or 5 years, may be taken up and sold at a discount of only 15 to 25 per cent. from the first cost, according to the demand at the time. Second-hand pipe in large quantity is always more or less in request.

Sizes of pipe from 10 inches to 2 feet in diameter are frequently laid with the Converse joint, in connection with which the pipe has plain ends, the connections being made by heavy cast iron sleeves, or hubs, filled with molten lead, which is calked into the space between the pipe and the sleeve. This joint has the disadvantage that the packing may be loosened by the settling of the pipe and the movement due to changes in temperature. However, by the addition of a rubber packing pressed against the outside of the joint by means of iron clamps, a satisfactory connection can be made. Pipe lines of this construction have operated under a pressure of more than 300 pounds per square inch. For pipe lines of more than 2-foot diameter, cast iron water pipe or riveted steel pipe are put down. A line of riveted steel pipe 36-inch diameter, extending 20 miles southward from Pittsburg, Pa., cost approximately $50,000 per mile. At present, Pittsburg is receiving gas from points in West Virginia more than 100 miles distant, while the lines which supply Chicago, Toledo and Cleveland are considerably longer, the gas in some cases being conducted 200 miles.

Purification of Naphthaline and Anthracene.

Messrs. F. E. and E. A. Catchpole, of New Cross, London, England, have secured English Letters Patent (No. 16,641; July 29 last) for an invention which consists in exposing either naphthaline or anthracene, when in the crude condition, to a process of "sweating" by the application of dry heat thereto, so that the oleaginous matter or creosote contained therein may be liquefied and drained therefrom. Hitherto the usual and best known way of attaining the same ends has been by means of the process known as "hot pressing." But—to dispense with this costly process, and thereby commercially cheapen both the purified naphthaline or anthracene and the oil or creosote extracted therefrom—the patentees propose to place the block, slab, or other form of naphthaline mass into any suitable chamber to which heat may be applied in dry form (either by a jacketed arrangement, or by pipes or conduits passing therethrough or thereround or both); while the heat used may be derived from any available source, which may conveniently be that of live or exhaust steam or other means.

The block of naphthaline is mounted in the chamber on a staging or platform of grid-like or channelled formation, constructed of wire netting, perforated metal, channelled or perforated concrete, bricks, or tiles, or other materials; while means may be provided by which the oil or creosote, as drained therefrom, may be led by suitable conduits from the chamber to where required. The naphthaline block having been placed in position upon its staging or platform, the chamber would then be closed, and the source of heat opened, and the heat applied thereto. For preference, the patentees at first employ a low temperature, gradually rising until a temperature is reached suitable for liquefying the oil or creosote, and draining this from the naphthaline. In practice, they find the most suitable temperature to be 70° C. or thereabouts; the character or quality of the resultant naphthaline depending to some extent upon the duration of this operation and the temperature employed. It is, however, easily possible, by suitably regulating these conditions, to obtain, in the case of naphthaline, a material melting at 79° C.

With naphthaline purified by this process, the ordinary well known operation of chemical washing may be omitted, if only a second grade quality of naphthaline is required. For a purer quality, the quantity of chemical materials used in washing may be considerably reduced, as compared with the quantities of chemicals employed in combination with the present expensive process of hot pressing. Thus the invention, it is claimed, effects a great saving in this direction also. It is likewise found that the subsequent distillation may be carried on until the still be as near as possible empty, as a uniform product distils over to the finish absolutely.

This system of purifying naphthaline may also be employed in the purification of the anthracene; the only difference in the process being the employment of a higher maximum temperature (about 200° C. being found sufficient), which may be derived from superheated steam or other suitable means.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. W. A. Warmington has been appointed General Superintendent for the Consolidated Gas and Electric Company, of Batavia, N. Y., the entire properties of which are now controlled by the Consolidated Industries Company, of New York.

As was predicted in the last issue of the Journal would be the case, Mr. A. C. Humphreys, of New York, has been elected a Director in the Consolidated Gas Company, of Baltimore, Md.

The shareholders in the Mansfield (O.) Gas and Electric Light Company have elected the following Directors: Wm. C. Hedges, W. S. Kerr, C. W. Upson, H. M. Weaver, M. B. Bushnell, J. P. Steward and J. S. Hedges.

The Schenectady (N. Y.) Railway Company has been granted authority by the State Railroad Commission to make a large increase in its capitalization. Part of the proceeds under this permission goes on account of the acquirement of the Mohawk Gas Company at Schenectady, which will likely prove the best jewel in the Railroad Company's miscellaneous casket.

The Municipal Gas Company, of Albany, N. Y., has declared its regular dividend, for the past quarter, amounting to 2½ per cent.

Mr. S. L. Miller, formerly of Medfield, Mass., has been appointed Manager of the Guthrie (Okla.) Electric Light and Gas Company.

The City Council, of Bay City, Mich., has declared forfeited the franchise of the Hecla Portland Cement and Coal Company, under the provisions of which the latter proposed to supply gas in Bay City. The adverse action was based on the failure of the Hecla Company to register the bond originally specified.

Mr. George Keaton has resigned the place of Superintendent to the municipal gas plant at Gilroy, Cal.

The following is from a correspondent in Boston, Mass., who wrote under date of the 14th inst.: "About 20 stockholders were present at the annual meeting of the Massachusetts Gas Companies, held in Boston yesterday. The following Directors were elected, to act for 2 years: C. F. Adams, II., Samuel Carr, W. C. Bayliss, R. C. Pruyn and J. B. Russell. The income account shows no dividends received in the shares of the Addicks Companies. This matter is a subject of litigation and by agreement of counsel dividends have been withheld from the Massachusetts Gas Companies. They have been used, however, to improve the plants, and have in this way strengthened the intrinsic values of the stocks of these Boston Companies. Pres. Weld stated that there was an effort being made to annul the sale of the Addicks Companies' stock which has been made to Kidder, Peabody & Co., in full accordance with the rulings of the court. 'The $11,000,000 paid for these Companies,' said Mr. Weld, 'was more than the Companies were worth to any other interest than the Massachusett Gas Companies, but they were worth that price to us. I think that the sellers would be

quite averse to giving us back our $11,000,000 if the sale should by any chance be declared void.' Several stockholders wanted to know when a dividend on the common stock might be expected, and the reply was that it was too early yet to make any definite prediction. The common stock was declared to be making a very satisfactory showing of earnings, and this statement would seem to be confirmed when reference is made to the income account presented. Combining the dividends and interest received during the nine months ended June 30, with the undivided net earnings of all the constituent Companies and the earnings for the Massachusetts Gas Companies for this period are shown to be as follows:

Dividends and interest received.....	$766,117
Undivided net earnings, all Companies.....	734,764
Total for nine months.....	$1,490,881

"These nine months' earnings are at the rate of $1,987,841 per annum, or in round numbers $2,000,000. This is equivalent to 4 per cent. on the $25,000,000 of Massachusetts Gas preferred, and 4 per cent. on the $25,000,000 common. Meanwhile I might add that the actual cash for dividends is not yet in sight."

MR. E. G. HOLZER, Superintendent of the Easton (Pa.) Gas and Electric Company, writing under date of the 15th inst., relates as follows some of the things that happened to the Company during the famous downpour of rain that visited the Middle States something over a fortnight ago: "Thursday and Friday, the 8th and 9th inst., there was a continuous downpour of rain. Friday the Lehigh and Delaware rivers commenced raising, backing the waters up in the Bushkill creek. Friday afternoon message came down from the headwaters of the Delaware to look out for high water. These messages are of quite frequent occurrence in this locality, and certain precautions are usually observed; but no preparations were made at the gas plant, the waters not having raised sufficiently to do any harm to the plant since 1862. On Saturday morning the retort house men called me out on account of the quick raise and alarming amount of water in the creek, the water then being with about 2½ feet of the top of stone wall marking the works yard level. I at once called out what men I could reach by 'phone and sent them off for all the labor obtainable. By 7 A.M. we had about 40 men carrying material to higher ground. We are just about to install a new water gas apparatus, the material for which was all on the ground, besides building material for our new plant. By this time the water was slowly pouring over the wall into yard and creeping towards the retort house. Bags of cement were dropped in the doorway and banked up with sods in order to keep the water out as long as possible. The fires were drawn from benches at 7 A.M., and before the completion of this work the water was creeping up in the pits; charges were being drawn at same time. About 8:30 the boiler fire was extinguished, and by 9 the water entered our lower retorts. Gas was shut off from town at 11:15 A.M. The water continued to raise until 10 P.M., Saturday Oct. 10th., at which time the middle retorts were under water, and 5½ feet of water went rushing through the yards like a mill race, sweeping along all before it. The new 6-foot shells were tied to trees; the 30-inch iron smokestacks for new boiler were starting off on a trip down the street when the three sections were caught and tied up. The writer left the plant about 11:30 P.M to seek some much needed rest —my home being submerged by 6 feet of water, was also abandoned. On reaching the works at 6 A.M., Oct. 11th., I found the water had left the retort house but was not yet out of yard; one of the retort men was already on the ground. We immediately set to work to obtain a force of men, which was a difficult task. Men had a greater desire to see the effects of the flood in all quarters than a wish to work; however, by 9 o'clock I had 28 or 30 men in the retort house, got one steam pump at work, started two bucket brigades and one boost pump all on the pipes and at same time my assistants had other men cleaning up the yard— at 3 P.M. we started fire in the water soaked benches, ran fire slowly about 8 hours, then opened up all drafts and fired up with all possible speed, taking serious chances to be sure; but we wanted gas at the earliest possible moment, and without heats we could not make it. Monday evening the plant was in a neat condition and showed little effects of the ducking, except pretty good sized gaps in the retorts. The retorts were patched up, and first charges were thrown in at 3 P.M., Tuesday, but not a foot of gas passed the meter until after 5 P.M., all going out the stack. Conditions improved somewhat during the night, and for the 12 hours meter registered 26,700 for 32 retorts. Wednesday morning, 10 o'clock, gas was turned on the town, and although we had men during Monday and Tuesday pumping drips, exchanging meters, cleaning service pipes, etc., we found trouble in getting things in proper working order for a couple of hours; but by 2 P.M. everything was going along smoothly. Gas stoves were started, and on Wednesday night the town had all the gas required. The writer is well pleased and considers himself particularly fortunate to come out of the flood with so small a loss. Our retorts were under water 15 hours. Fires were started immediately the water was pumped out of pits and first charges made in just 48 hours."

THE Coudersport (Pa.) Gas Company has been granted the right to supply gas to the outlying village of East Emporium.

MR. NORMAN G. KENAN has been formally elected President of the Cincinnati Gas and Electric Company. He has been Acting President of the Company since the resignation of General Andrew Hickenlooper last May, and it was the latter's wish that Mr. Kenan should succeed him. Mr. Kenan entered the service of the old Cincinnati Gas Light and Coke Company as a bookkeeper in 1868, and the following account of his services thereto and promotion therein is of much interest, in that it shows how faithful and capable service under appreciative eyes is rewarded. "Mr. Kenan was born in Boston in 1845, and at an early age went to Cincinnati with his parents. Late in the '50's' his father was appointed Superintendent of the West End works of the old Cincinnati Company. The latter died during the cholera plague of 1866, and young Kenan accepted a position as cigar salesman at the St. Lawrence restaurant, Fourth street, near Vine, where the new Third National Bank now stands. Later he secured a position as conductor on the old Third and Fifth street car line, and he retained that position until December 15, 1868, when he secured a position as Assistant Clerk at the Gas Company's works In 1873 he was made Chief Clerk in charge of the office of the West End Station, and in 1884 was made Superintendent of the West End works. In 1887 he was made Engineer and General Manager of the combined East End and West End stations, which position he retained until 1880, when he was brought to the main office of the Company as an assistant to the President. This was followed by his appointment as Vice-President of the Company in 1892, which position he held until his last promotion."

THE Peter English system of gas making is being installed in the generating house of the Deadwood (So. Dak.) Gas Company.

THE Shawnee (Okla.) Gas Light, Fuel and Power Company has been incorporated with a capital of $100,000, by Messrs. D. C. Williams, J. W. Tilford, W. L. Chapman, F. P. Stearn and H. G. Beard.

THE salary of Mr. William B. Bourn, President of the San Francisco Gas and Electric Company has been fixed at $25,000 per annum; at least so says the San Francisco *News-Bureau*. Meanwhile it is well to remember that no compensation in the shape of salary has been voted by the Company to its late Director, Mr. Rudolph Spreckels.

THE main office of the Watsonville (Cal.) Gas Company has been removed from San Francisco to Watsonville.

MR. L. B. JOHNS is now in full charge of the plant and office force of the Dedham and Hyde Park (Mass.) Gas and Electric Light Company.

UNDER the proposition submitted to the authorities, by which Mr. C. T. Smith, of Moline, Ills., seeks the right to manufacture and distribute gas in Aledo, Ills., the petitioner agrees to charge not to exceed 75 cents per 1,000 cubic feet "for a gas equal in quality to that supplied by any company in the State which supplies coal gas."

THE plant and franchises of the Traverse City (Mich.) Gas Company have been purchased by the owners of the Boardman River Electric Light and Power Company, the control of which is held by certain residents of Traverse City.

COCHISE CITY, Ariz., is bargaining for a gas works, and another Arizona borough that asks for the establishment of a gas plant is Douglas.

THE Brooklyn (N. Y.) *Daily Eagle* says that the Garden City Gas Company has sold its interests to the Nassau Gas Company, the aim of whose promoters is to supply gas throughout Nassau county, L. I.

PORTERFIELD, Cal., wants a gas works, and Mr. E. E. Bush, of Hanford, Cal., is endeavoring to secure the franchise therefor.

(*Continued on page* 654.)

THE AMERICAN GAS LIGHT JOURNAL

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, OCTOBER 26, 1903.

(*Concluded from page* 653.)

A CORRESPONDENT in New London, Conn., forwards the following: "An opening gun in the proceedings to oust the Westerly Gas and Electric Company from doing business in Connecticut has been fired. Legal proceedings were instituted in the Superior Court, New London. The action is brought by Thomas C. Perkins, of Hartford, President of the Mystic Gas and Electric Company, a corporation situated in Mystic, in the town of Stonington, Conn. Clerk John C. Averill, of the Superior Court, issued a *quo warranto* writ against the Westerly corporation, which is made returnable to the Court in Norwich on the first Tuesday in November at 2 P.M. In his prayer for the writ, Mr. Perkins by his attorney stipulates that the Westerly Gas and Electric Company is a foreign corporation, chartered to do business of selling gas and electricity for lighting purposes in Westerly, in the State of Rhode Island, and the Company exists under the Rhode Island laws. It is stipulated that the Westerly concern is selling its product in Connecticut and maintaining lines and poles contrary to its charter, and the petitioner asks that the corporation be ousted from the State. The Westerly Gas and Electric Company's plant is situated on the Connecticut side of the Pawcatuck river opposite the village of Westerly, and the Company has been a target for criticism in Westerly, where there is considerable of a demand for municipal lighting. The concern is said to operate a plant entirely inadequate to the needs of the village of Westerly, where the electric street lights are maintained only till midnight. The proceedings brought by Mr. Perkins will prove highly interesting to Mystic, Stonington, Pawcatuck and Westerly."

MR. FRANK THOMPSON has been reappointed Superintendent of the Wheeling (West Va.) municipal gas works, and Mr. Homer C. Underwood has been reappointed Superintendent of the electrical division of the same property.

ON the 2d prox. the shareholders of the Consolidated Gas and Electric Company will vote on a proposition to increase its capital stock from $200,000 to $300,000.

THE Colton (Cal.) Gas Company has been incorporated by Messrs. George B. Ellis, Henry Fisher, F. P. Morrison, H. W. Allan and H. H. Sinclair. It is capitalized in $100,000.

The Market for Gas Securities.

The bona fide speculators seem to have reached the conclusion that all's not dark that's shady, and in such changing view are now evidently buying for an advance. It might fairly be considered that, between the showing up of different celebrities in various lines, such as Schwab, Nixon, Parks and others, the worst possible has been told, wherefore dear, old "confidence" in the future urges the "lamb" to make another try in Wall Street. That the public is again in evidence there is no doubt, but this time the public is buying for cash.

As far as gas securities are concerned, those in the local list have maintained the higher figures set for them in the final trading of a week ago. To-day (Friday) Consolidated closed at 173½ to 175½, and Brooklyn Union is 180 bid. Notable advances were scored in Peoples, of Chicago; Laclede, preferred, and Washington, D. C. We repeat our advice to keep Consolidated, of Baltimore, well in mind. Mr. Norman G. Kenan has been elected President of the Cincinnati Gas and Electric Company, which means the continuance of the modern conservative style of sensible, safe management.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks,

16 WALL STREET, NEW YORK CITY.

OCTOBER 26.

☞All communications will receive particular attention.

☞The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$78,177,000	100	173¼	175½
Central Union, Bonds, 5's.	3,000,000	1,000	104	106
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000	..	108	112
Mutual	3,500,000	100	280	295
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	103	105
Northern Union, Bonds, 5's.	1,250,000	1,000	105	106½
New York and East River				
Bonds 1st 5's	3,500,000	1,000	102	106
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	135	140
Preferred	5,000,000	100	155	170
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	180	..
" " Bonds (5's)	15,000,000	1,000	119	119½
Bay State	50,000,000	50	⅛	¼
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central, San Francisco	1,900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	92½	92¾
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	60	60½
Mortgage, 6's	3,600,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	86	90
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	87	95
" Prior Lien 5's	5,603,000	1,000	99¼	100
Detroit Gas Co., 5's	351,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,235,000	1,000	104½	105
Hartford	750,000	25	245	255
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	50	65
" Bonds, 6's	2,650,000	..	103½	106½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	79	90
Preferred	2,500,000	100	85½	..
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	250,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	250	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	93½	93¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	0,000,000	100	..	..
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	92	96½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047,000	1,000	94	96
Washington, D. C	2,600,000	20	283¾	288¾
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del	600,000	50	202	..

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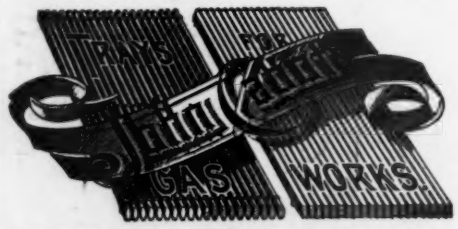

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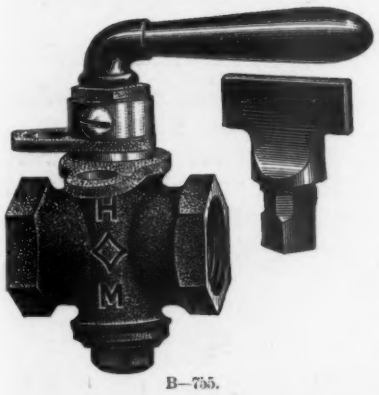

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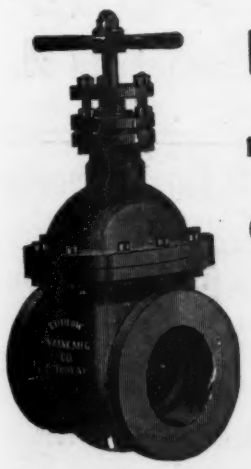

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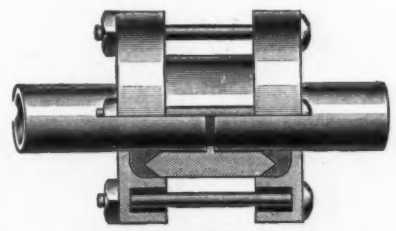

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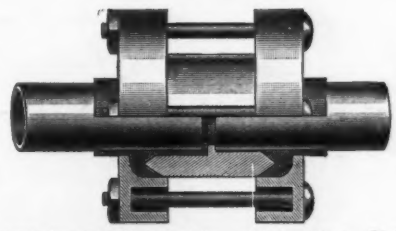

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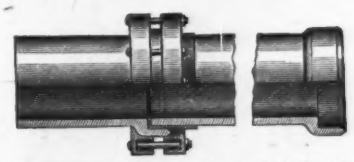

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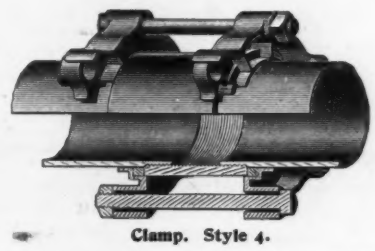

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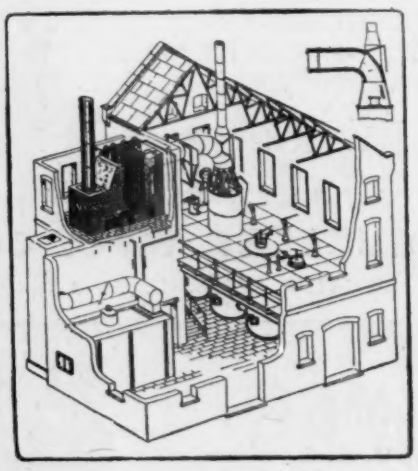

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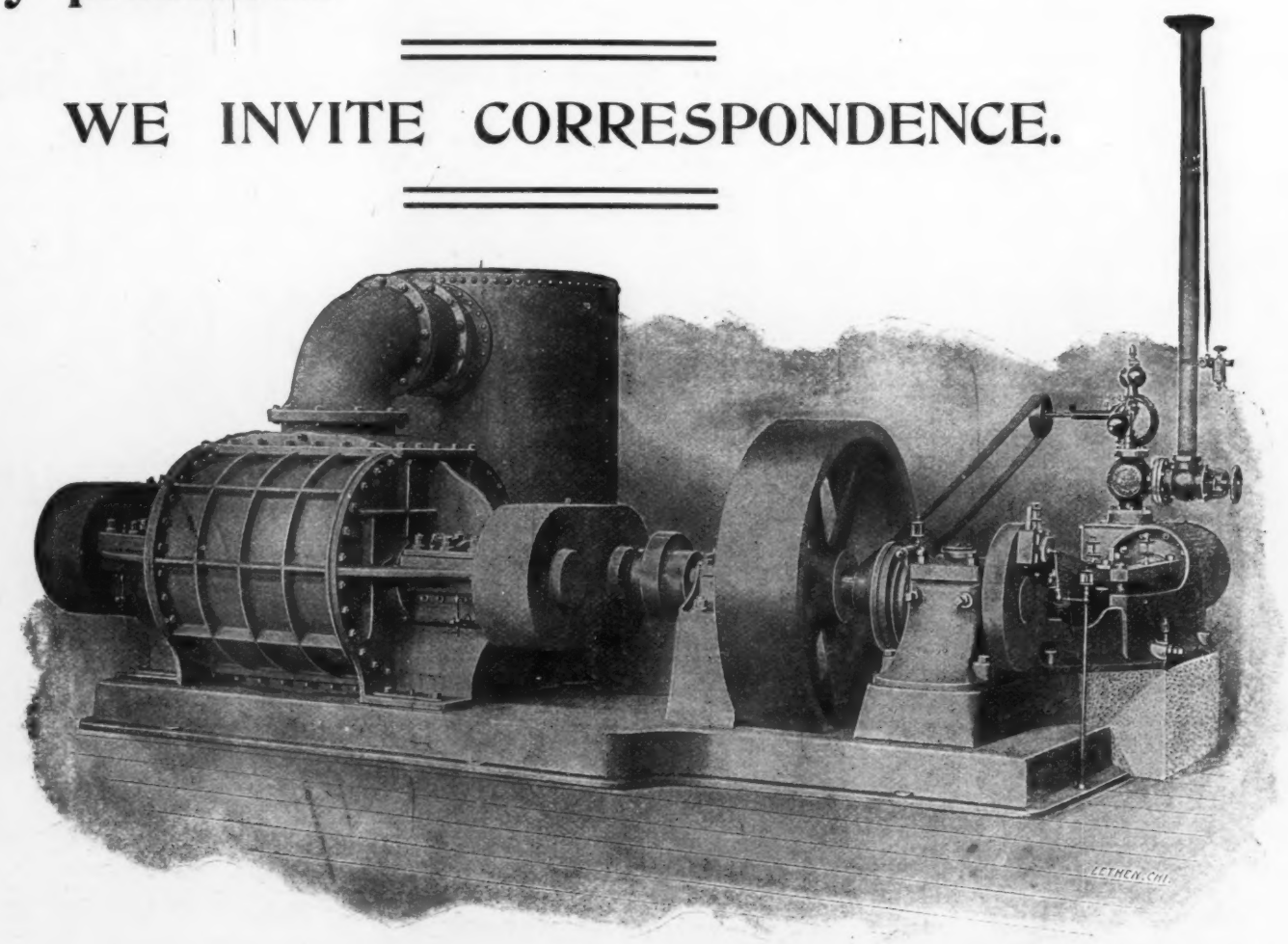

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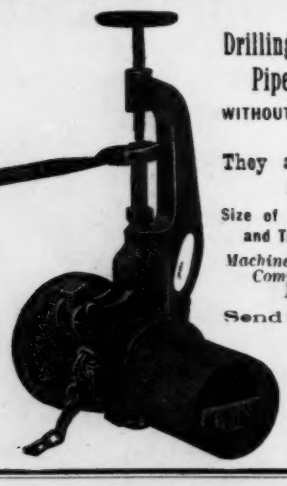

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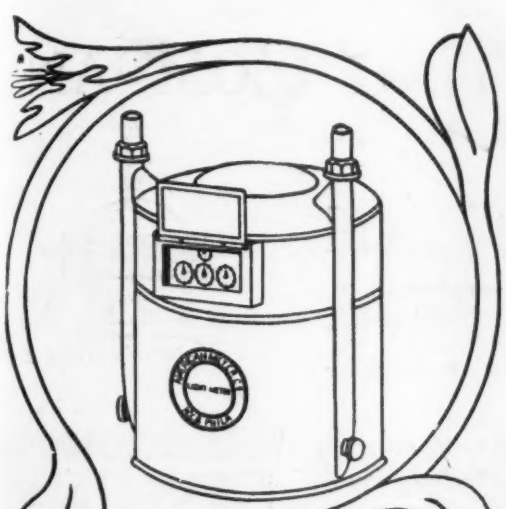

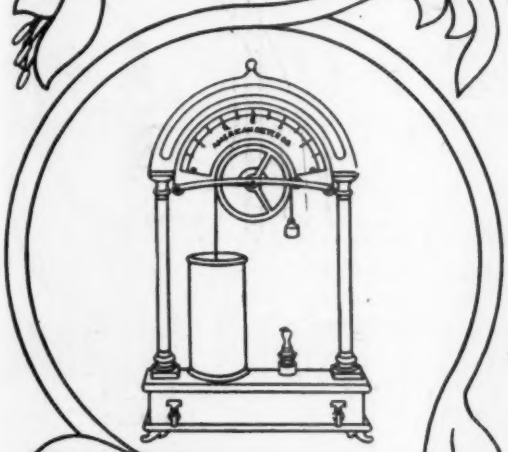

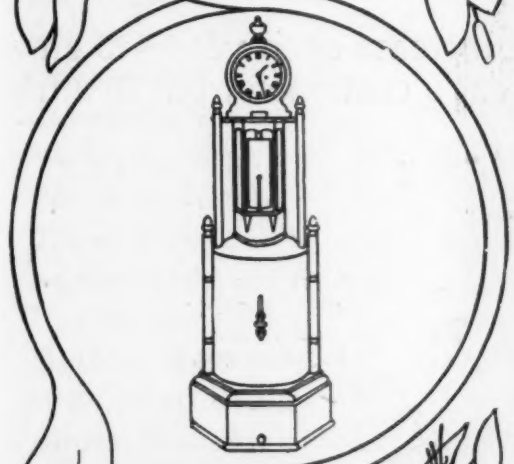

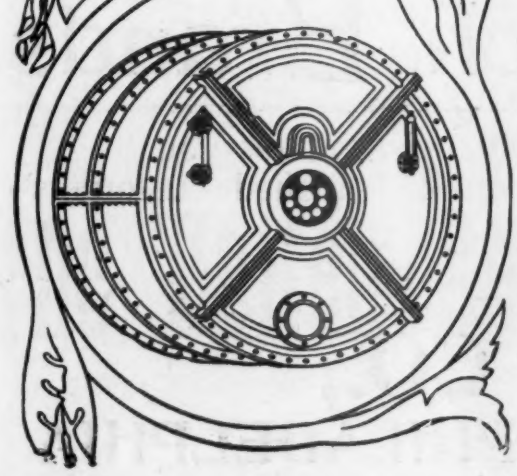

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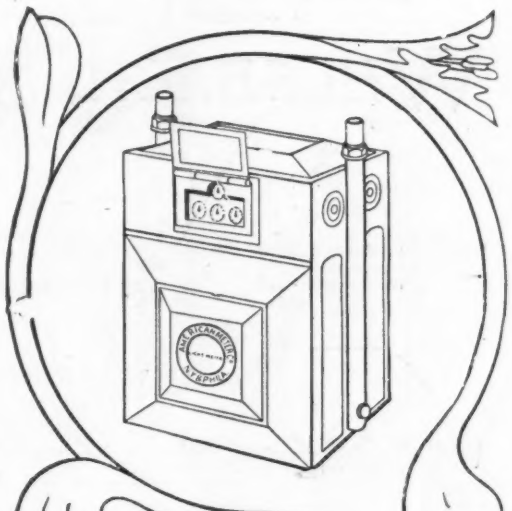
PUBLIC LIGHTING TABLE.

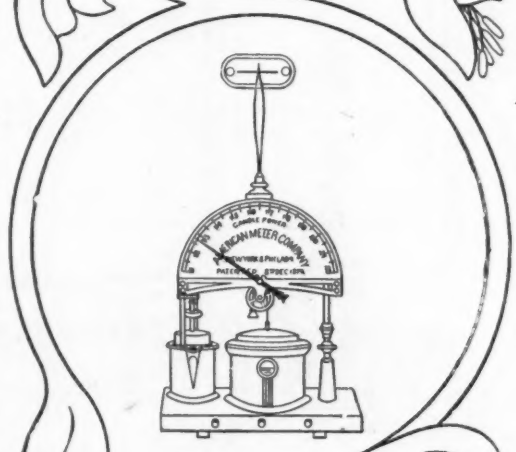
NOVEMBER, 1903.

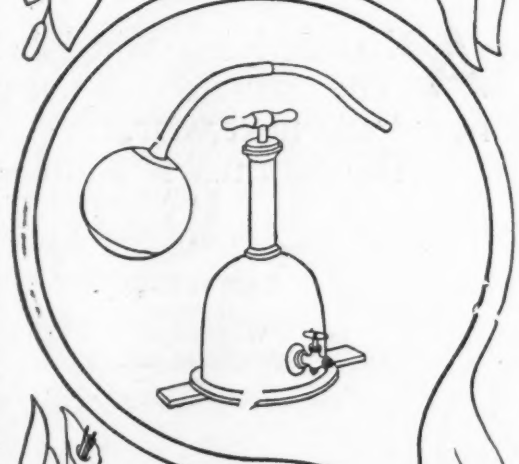
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	2.40 AM	5.30 AM	4.45	5.35
Mon.	2	3.40	5.30	4.45	5.35
Tue.	3	No L.	No L.	4.45	5.35
Wed.	4	No L. FM	No L.	4.45	5.35
Thu.	5	No L.	No L.	4.40	5.45
Fri.	6	5.20 PM	7.20 PM	4.40	5.45
Sat.	7	5.20	8.10	4.40	5.45
Sun.	8	5.20	9.10	4.40	5.45
Mon.	9	5.20	10.10	4.40	5.45
Tue.	10	5.20	11.10	4.40	5.45
Wed.	11	5.20 LQ	12.20 AM	4.40	5.45
Thu.	12	5.20	1.30	4.30	6.00
Fri.	13	5.20	2.40	4.30	6.00
Sat.	14	5.20	3.40	4.30	6.00
Sun.	15	5.10	5.50	4.30	6.00
Mon.	16	5.10	5.50	4.30	6.00
Tue.	17	5.10	5.50	4.30	6.00
Wed.	18	5.10 NM	5.50	4.30	6.00
Thu.	19	5.10	5.50	4.25	6.00
Fri.	20	5.10	5.50	4.25	6.00
Sat.	21	5.10	5.50	4.25	6.00
Sun.	22	5.10	6.00	4.25	6.00
Mon.	23	7.40	6.00	4.25	6.00
Tue.	24	8.40	6.00	4.25	6.00
Wed.	25	9.30	6.00	4.25	6.00
Thu.	26	10.30 FQ	6.00	4.20	6.10
Fri.	27	11.30	6.00	4.20	6.10
Sat.	28	12.20 AM	6.00	4.20	6.10
Sun.	29	1.20	6.00	4.20	6.10
Mon.	30	2.20	6.00	4.20	6.10

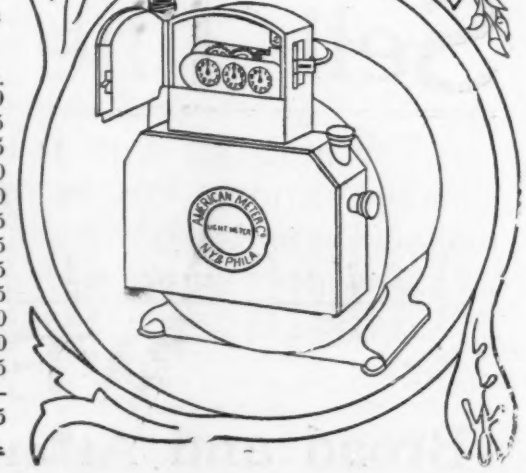
TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45









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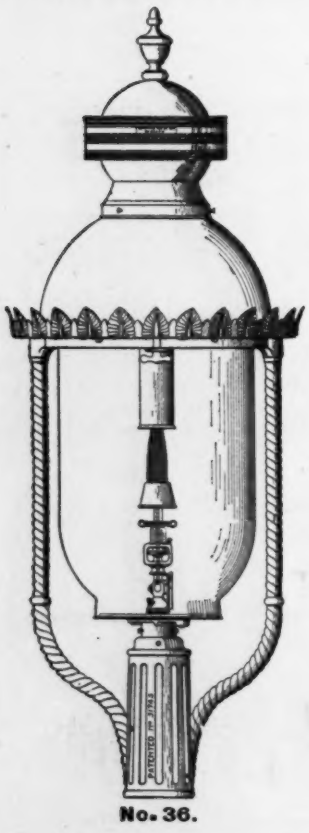
.... OF AMERICA ....



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Hagerstown, Md.	Charlotte, N. C.	Lawrence, Mass.
Malden, Mass.	Fall River, Mass.	Council Bluffs, Ia.
Bridgeport, Conn.	Duluth, Minn.	Chattanooga, Tenn.
Albert Lea, Minn.	New York (Mutual Co.)	

TOTAL SETS TO JULY 1, 1903, ... 51
TOTAL DAILY CAPACITY, ... 55,150,000 cubic feet.
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TOTAL DAILY CAPACITY, ... 354,830,000 cubic feet.

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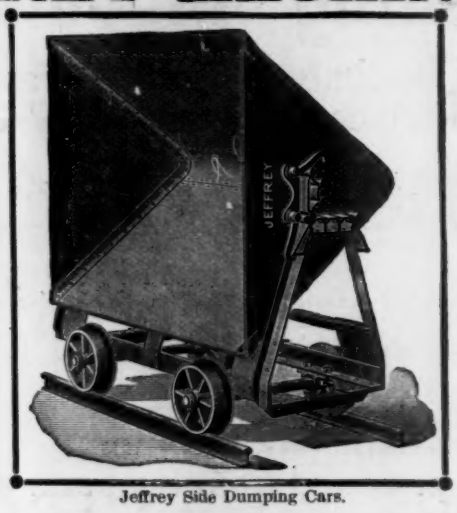

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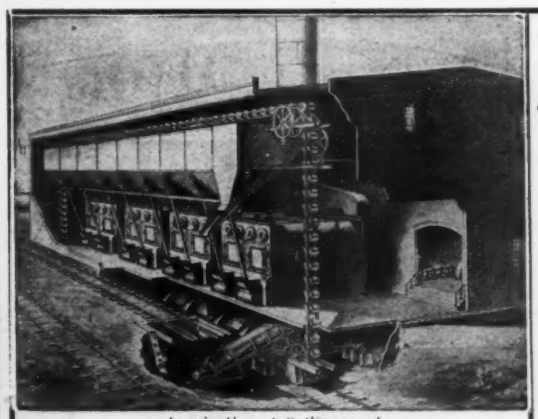

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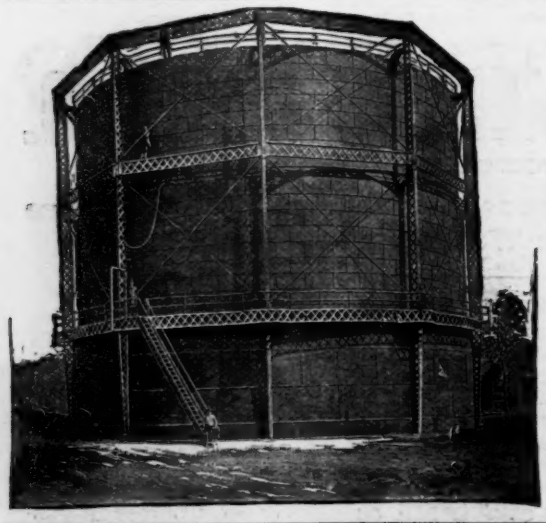

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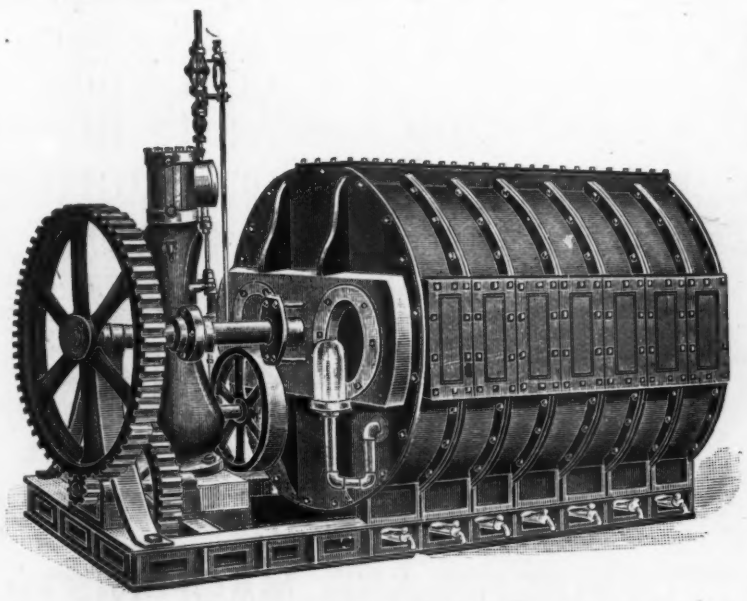

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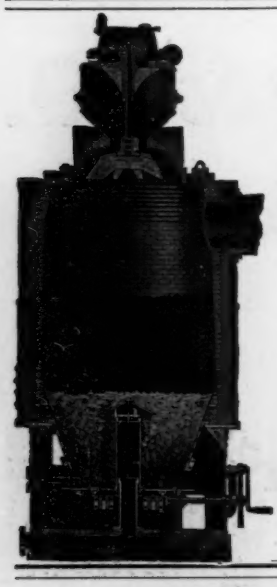

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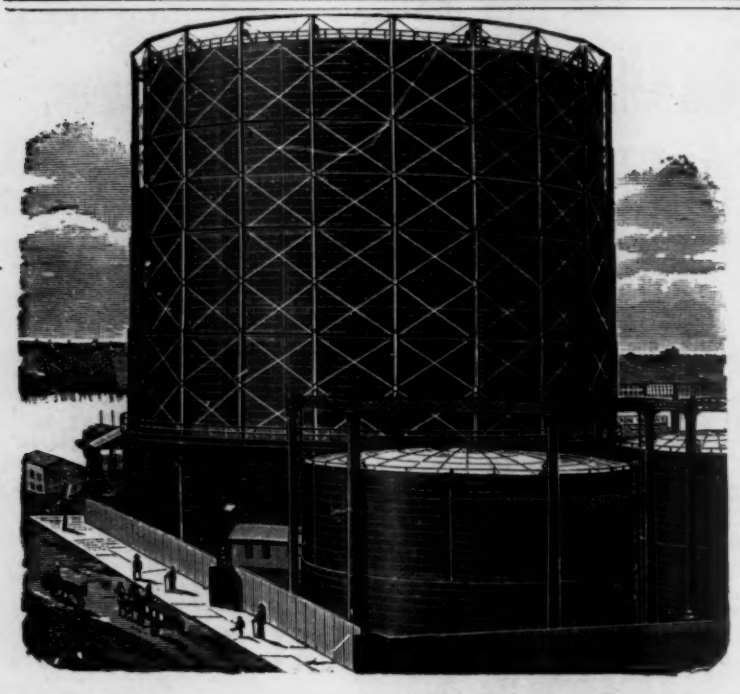

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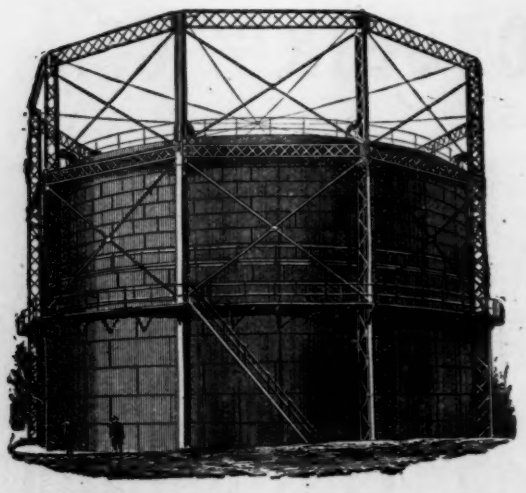

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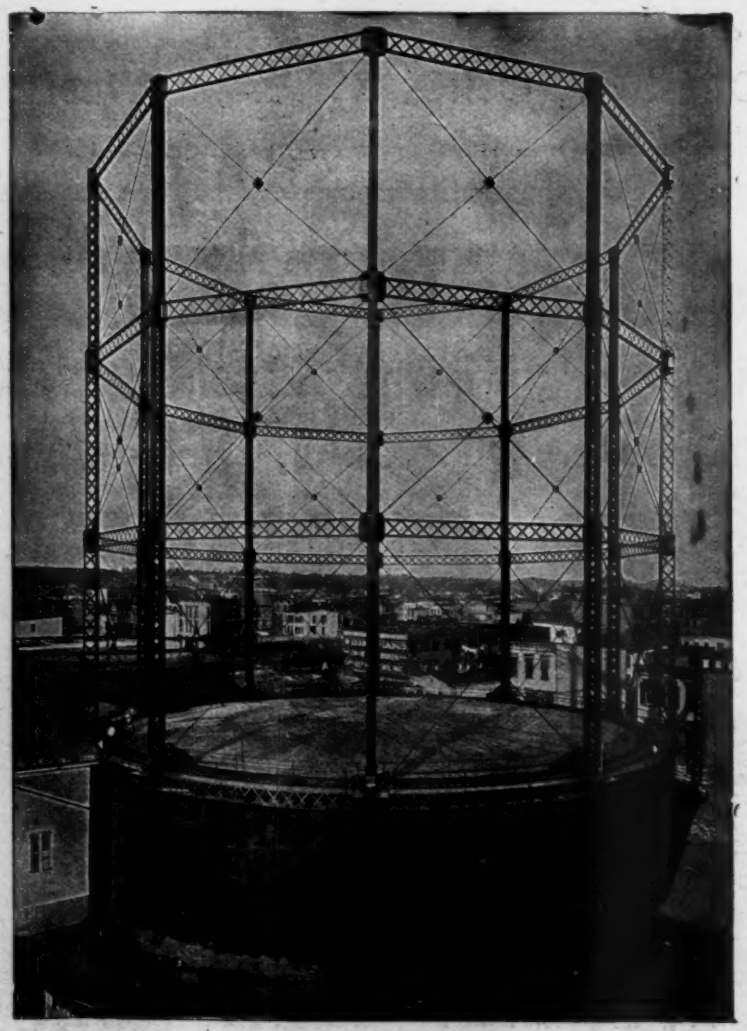

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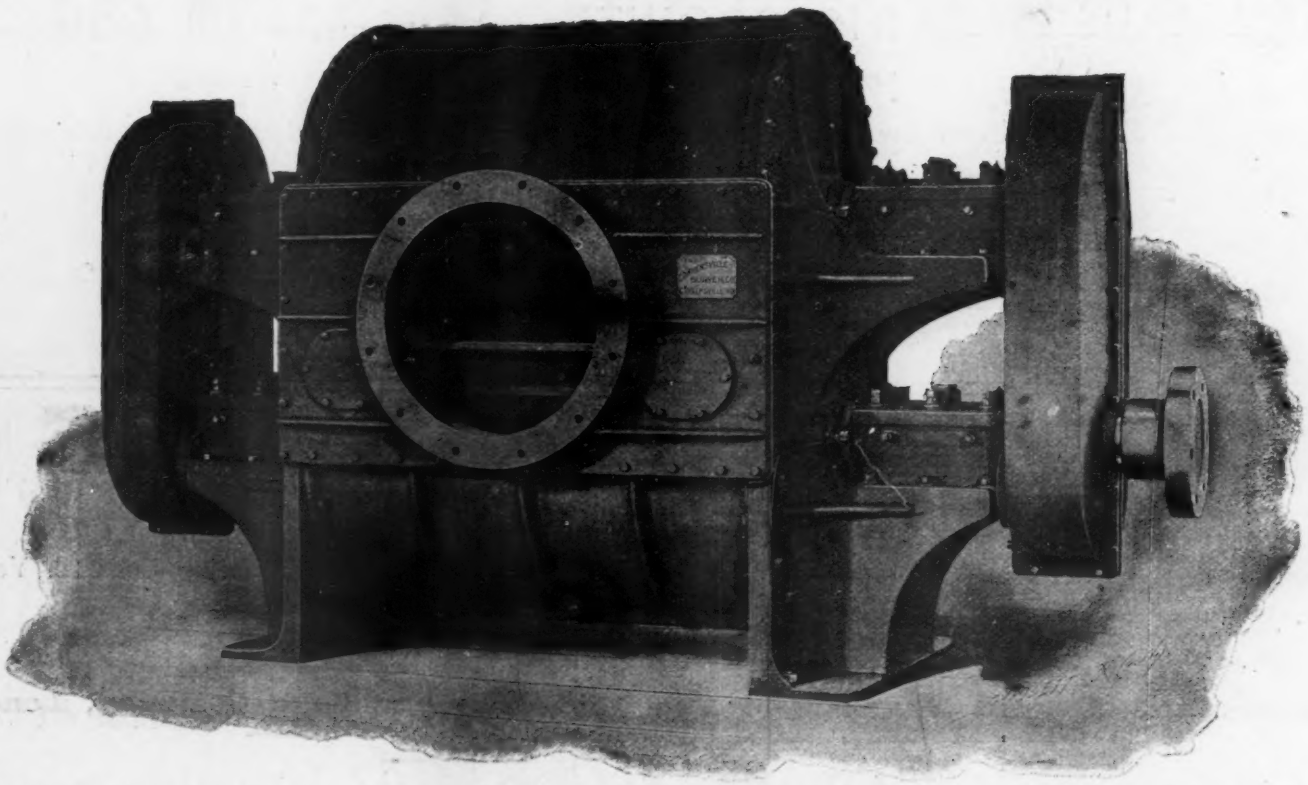

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